Motorship

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Motorship

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Shipping Board's First Converted Ship

Commissioning of Ms. Tampa Last Month Initiates the Final Stage of the Government's First Diesel Conversion Program Embracing 12 Vessels

MOTORSHIPS tireless campaign of almost 10 years waged for the adoption by the Government of Diesel engined vessels with their superior economy has brought forth the motorship TAMPA, soon to be followed by 11 other motorships of about the same size, which will form the nucleus of a fleet of 50 motorships under Shipping Board ownership.

TAMPA ran her acceptance trials off the Virginia Capes in November and was ordered the next day to proceed to Savannah, Ga., and load a cargo of cotton for Bremen, Germany, initiating the operation of the first vessel of the Shipping Board's Diesel Conversion Program.

It is appropriate that the first ship in commission has an engine representing an American development of such advanced type that few examples are yet in service anywhere in the world.

Ms. TAMPA has a double-acting 2-cycle engine, and there was no engine of this class under any registry until about a year ago when the German development began to show itself. (It is true that experimental machinery of this type was installed years ago in a German ship, but it was scrapped.)

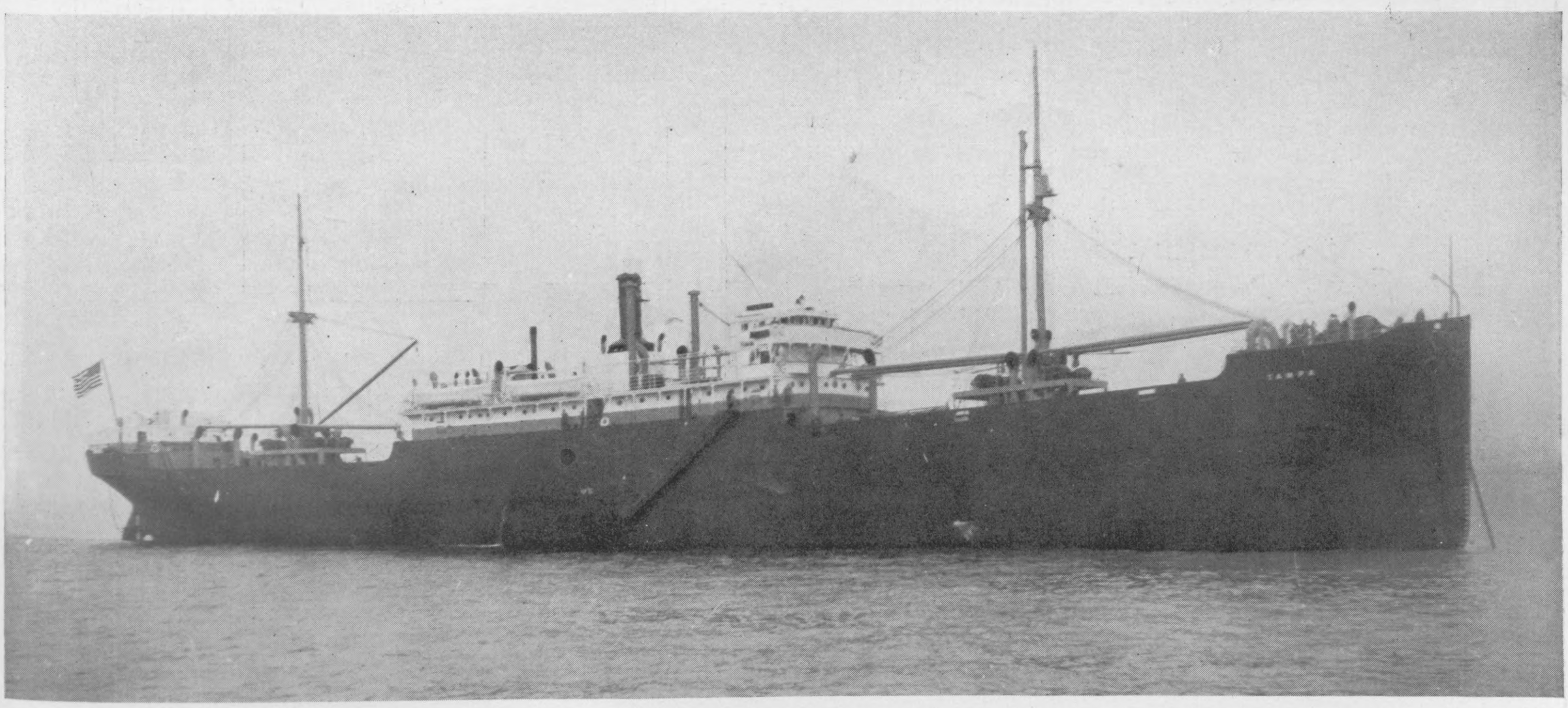
TAMPA therefore represents the bolder part of the Shipping Board program. Yet she enters service with considerable assurance of success, for her engine was submitted to very searching trials under official observation and completed them without breakdown. The authenticated record of the trials is reproduced in full on another page and demonstrates how free from trouble even this newest design of Diesel engine is. No Diesel engine trials anywhere in the world have ever yet been reported so frankly and exactly as these Shipping Board tests.

Two of the most important benefits of the Shipping Board's Conversion Program are first the encouragement and support it has given to the marine oil-engine industry and second the demonstration it affords to shipowners of the dependability of the engines.

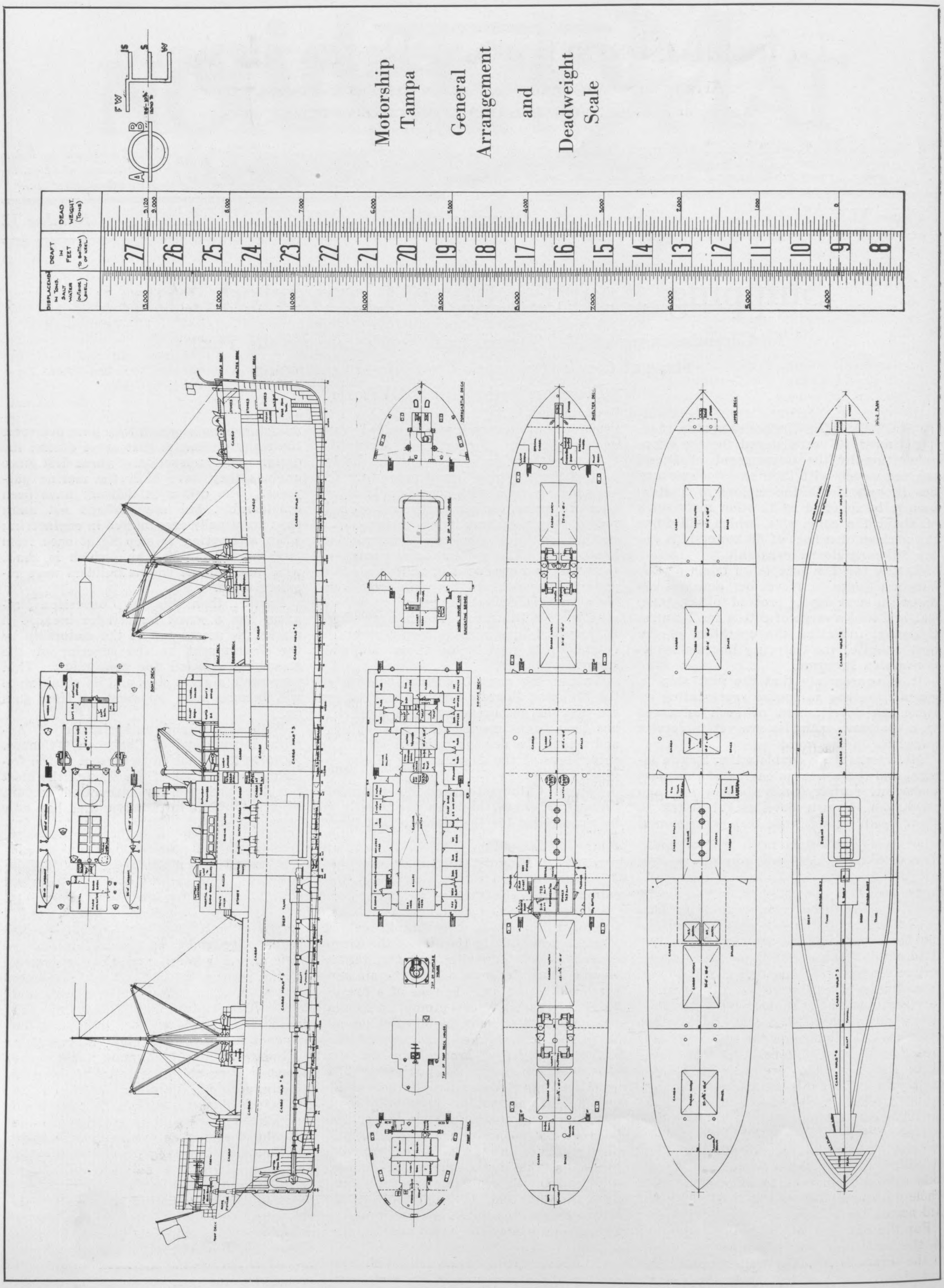
Captain Gatewood makes the statement: "American engine builders are greatly to be commended for the vigorous and determined manner in which they have overcome the many difficulties that arose during the design and construction of these first large engines they have built for marine purposes. The delays in delivery have been considerable, but are perhaps not more than are usually encountered in engineering when attempting to step all at once from 1000 b.hp. to 3000 b.hp., which is about what most of the engine builders were required to do."

Further than this the Conversion Program has a great importance because it marks the acceptance of the motorship by the Government as the superior of the steamship selected for conversion. That represents a great step, and its significance will become more apparent as time goes on.

With the special authorization of Admiral Benson and of Chairman O'Connor, MOTORSHIP is enabled to present in the following description of the TAMPA the most complete and usefully elaborated account of a motorship installation that has ever been published.



Tampa, first completed motorship conversion, under Shipping Board's program, is now on maiden voyage to Europe with full cargo



Motorship Tampa General Arrangement and Deadweight Scale

General Character and Design of Tampa

In Arrangement and Equipment of Cargo Spaces, Living Quarters, and Bridge All Modern Features Are Incorporated

TAMPA is a single-screw freight vessel of 9120 tons total deadweight capacity, equipped for service through the tropics, having a sea speed of about 11½ knots and accommodation for 11 passengers. Her 2900 hp. motor is of the very newest design, being of the double-acting 2-cycle type. She is not altogether new, having been completed in 1920 as a steamer, but she has been entirely reconditioned during her conversion to motor power at the plant of the Newport News Sb. & D. D. Co., and is the equal of a new vessel.

Entire credit for the general conception, detailed planning and specification of the changes and betterments in the TAMPA belongs to the engineering force of the Maintenance and Repair Division of the Fleet Corporation. What she was, how she has been altered, what her conversion has cost and how she contrasts as a motorship against herself as a steamer are treated in a separate article in this issue.

The ship is of the 3-island type, and the use of the term "shelter deck" on the drawings to designate the main strength deck is confusing, because this vessel is not of the shelter deck type. Built on the Isherwood longitudinal system with double-bottom tanks, she has 6 cargo holds (one of which is a deep tank), 'tween deck cargo spaces and also spaces for cargo in the poop, bridge and forecastle. These spaces give a capacity of 455,660 cu. ft. for bale cargo and 6560 bbl. in the deep tanks port and starboard, or a total capacity of 484,900 cu. ft. for grain cargo, including the deep tank.

Her tank capacity is 164 tons of fresh water in No. 4 double bottom tank and in the two tanks on the upper deck, about 775 tons of fuel oil and lubricating oil in the other double bottom tanks and 1238 tons of salt water in the deep tanks, fore peak and after peak, equal to a total of 2177 tons. With salt water in all tanks except the lubricating oil sump tank and the fresh water tanks, and with the latter filled with fresh water, the ballasting amounts to 2370 tons.

All the double-bottom tanks in which oil may be carried, and also the deep tanks, are fitted with heating coils. In the double-bottom tanks these coils are near the suctions and not of very large capacity, because normally these tanks do not have to be completely pumped out at one operation, the daily service tanks having a combined capacity of only 10 tons. For the deep tanks the conditions are different, shipments of vegetable oils, for instance, having to be discharged by special pumps and usually under the supervision of representatives of the shipper and of the underwriters. Discharge must therefore be expedited, and for this reason the heating coils extend from deck to bilge along the whole outboard sides of the tanks and are laid across the bottom.

For the handling of cargo into, and out of, the hold there are two winch platforms in the forward and after wells respectively and a third winch station on the boat deck to serve No. 3 hold. These winches accord with the tendency of American practice to use as high a hoisting speed as possible for the average lifts and hoist the heavier slings in double purchase. A rope speed of 185 ft. per min. is employed for weights below 4000 lb. which form the larger part of all bale cargo, but 10,000 lb. can be lifted in double purchase. The arrangements of the winches and of their controls is more fully described on page 917.

Characteristics of Ms. Tampa

Gross register	5959 tons
Net register	3703 tons
Length overall	416 ft. 0 in.
Length b.p.	402 ft. 0 in.
Beam, molded	54 ft. 0 in.
Depth, molded to main deck	33 ft. 9 in.
Displacement load	13,010 tons
Mean draft at above	26 ft. 10¾ in.
Power—main engine	2900 s.hp.
Service speed (about)	11½ knots
Endurance	14,000 miles
Total deadweight capacity	9120 tons
Fuel oil, double bottom	760 tons
Lubricating oil	16 tons
Fresh water	164 tons
Cargo deadweight capacity (full endurance)	8180 tons
Cargo deadweight capacity (half endurance)	8660 tons
Cargo spaces (bale)	455,660 cu. ft.
Cargo spaces (grain)	448,030 cu. ft.
Deep tanks (liquid)	6560 bbl.
Deep tanks (grain)	36,870 cu. ft.

Like all up-to-date motor freighters, TAMPA is equipped with a Lux-Rich system of fire detection and extinction. To detect the presence of fire in the cargo compartments, paint room and lamp room, a continuous sample of air is drawn from each space by means of an electric exhauster into a cabinet in the wheelhouse and there passed through a powerful beam of light which intensifies the slightest trace of smoke. To extinguish fires there is a bat of CO_2 cylinders in a separate room on the main strength deck, arranged in banks with a separate gas release handle for each bank. The banks comprise between 8 and 12 cylinders according to the size of the cargo hold connected therewith, and the gas is released slowly to drive out all the air and thus smother the fire. In case of a fire in the engine room, where prompt measures are essential to prevent the oil catching, all the banks are discharged simultaneously as soon as the alarm has brought the last man up to the deck. That flood discharge fills the entire engine room with inert gas at all levels and will blanket any fire.

All the living quarters are in the bridge structure and poop and are of the highest standard. For crew, as for officers and passengers, the living spaces are roomy, well lighted, well ventilated, properly protected against cold, thoroughly screened, equipped with fans throughout, with ample lockers, comfortably furnished and brightly finished.

All outside plating is sheathed with 2-in. cork insulation cemented to the steel with Hydrolene, a bitumastic compound which is both an insulator and a cement, unaffected by changes of temperature and a preventive of sweating. Over the cork is laid a paneling of Homasote composition board. The alleyway bulkheads and partitions between the rooms are ⅞-in. plywood, which is strong, deadens sound, is proof against warping and can be used in large panels, obviating joints. For the ceilings Vehisote composition board has been used, lighter than Homasote, but less expensive, and as durable as ceilings require. Selbolith flooring has been laid in all the quarters, except in the bathrooms and toilets, where tiling is used.

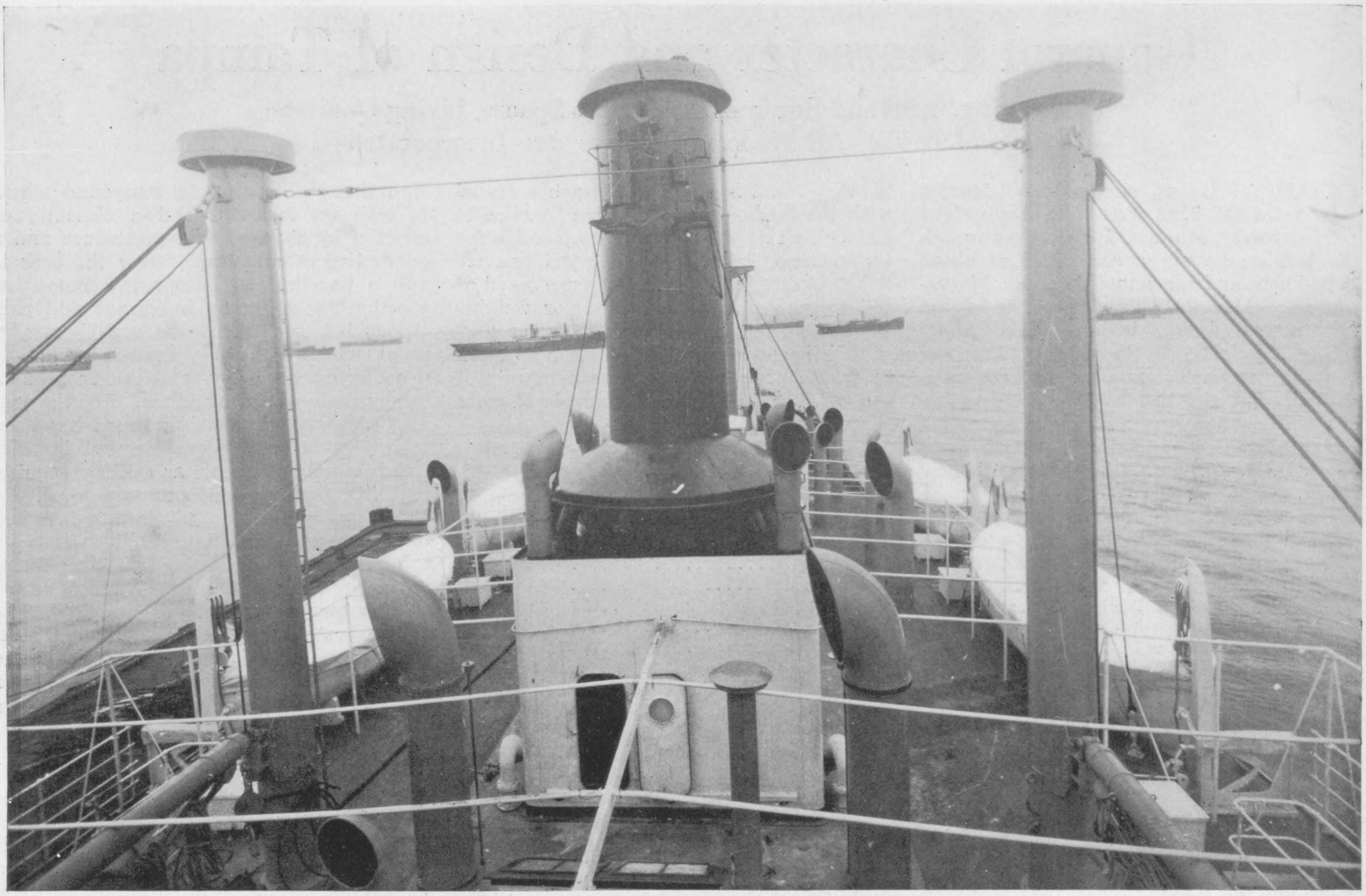
Wardrobes and berths in the officers' rooms are built-in, and in the crew's rooms steel lockers and pipe berths are used. The passengers' rooms have steel beds and steel berths over. Every room has at least one ceiling light, some with reflectors, and there is a wall light over each wash basin and mirror. Six rooms have desk lights. There is a Diehl electric fan in every room throughout all the quarters, and every room being an outside room has also been supplied with an air exhauster vent. These vents, like the air-ports and doors are all supplied with screens, and the ventilator spaces over the alleyway bulkheads between the deck beams are also screened.

Interior doors have slats in frames at top and bottom, and loose panels have been provided to cover these openings when required. It is the slatted sections that are screened. All exterior doors are of heavy teak with a 10-in. deadlight in the upper portion, and these doors are all backed up with a heavy screen door.

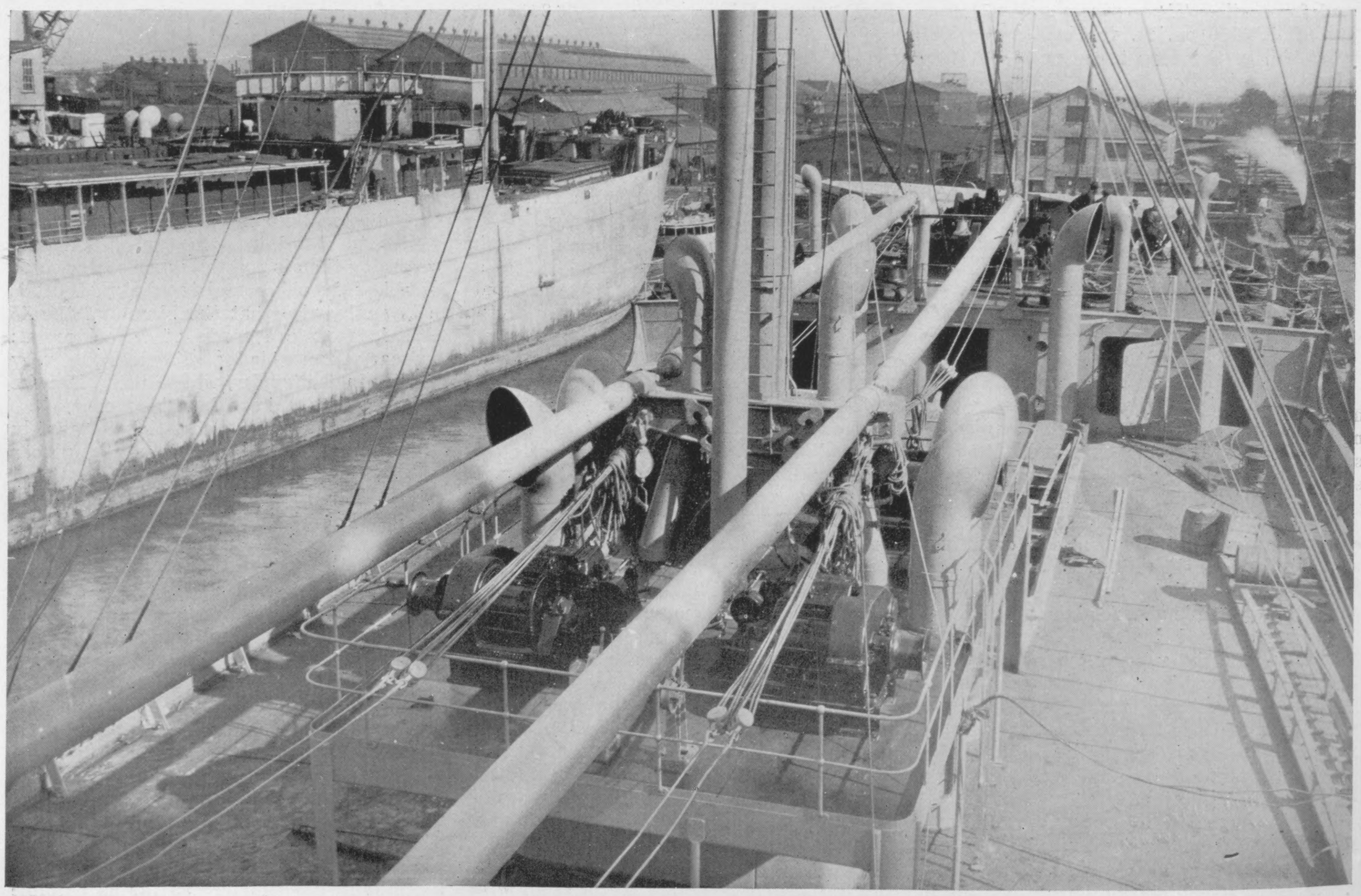
Monel metal screen wire is used all over, and there is no doubt that the use of a non-corroding metal is not only an economy, but serves to maintain a higher efficiency of screening than is possible when screen mesh of a less durable metal is employed. It is noteworthy also that the blades of the 45 electric fans are made of Monel metal: ordinary fan blades disintegrate very rapidly in the tropics, where a ship like the TAMPA will spend considerable time.

There are showers and toilets separately for the passengers, deck officers, engineer officers, chief engineer, petty officers and crew. The captain has a bath-tub and shower, and a bath-tub is provided also for women passengers. The hot water supply for the baths and for the wash basin in the cabins is maintained by automatic electric heaters, of which there are two, one in the quarters amidships and on in the crew's quarters aft. For the plumbing, genuine wrought iron pipe has been employed without exception, and all pipes liable to sweat are covered with a 2-in. thickness of hair felt, wrapped and painted.

In addition to the dining room, with seats for 16 at two tables, there is an officers' mess, a P.O.'s mess and a crew's mess. These are all handy to the galley, and that indeed is one of the principal reasons for assembling the quarters as far as possible



Viewed from the navigating bridge, Tampa presents the characteristic neatness of the motorship, while her stack gives distinctiveness



Much thought has been given to the efficiency of cargo handling arrangements and the disposition of the winches in the wells is noteworthy

in one superstructure. For TAMPA the length of the bridge structure—which was fixed by prior determinations—was insufficient to permit the inclusion of the seamen's quarters, while considerations of height did not permit the arrangement of crew's quarters underneath officers' and passenger accommodations, as done in many modern ships. Otherwise, there is little doubt the poop house would not be occupied.

Cooking is done on a range of Shipping Board design built by the N. Y. French Range Co., embodying a Ray oil burner. The work table in the galley is supplied with Sepco electric immersion heaters for the Ray steam table, and there are also a 5-gal. Sepco electric water boiler and a 5-gal. Sepco electric coffee urn on a steel table. When the galley range is alight a supply of hot water is available from an 80-gal. hot water tank connected with the waterback on the range. At other times the electric water boiler must be used. In the galley and adjoining messrooms all flat surfaces like the table tops, dresser tops, sinks, pan racks, slatted shelves, table drawers, etc., are made of Armco rustless iron, the utility of which for marine service is becoming more widely recognized.

A large galley ice-box is cooled by coils from the refrigerator plant on the main deck immediately below. The refrigerator plant is capable of developing 2 tons of refrigeration (U. S. Standard) when operating in tropical waters and is of the ammonia type. It cools three spaces: one for vegetables, etc., to be held at 24 deg. Fahr., one for outward bound meat supply at 10 deg. Fahr. and one for homeward bound meat supply kept at zero Fahr. Their combined capacity is 3100 cu. ft.

On the boat deck aft are a hospital and radio room. The captain's office and stateroom are forward on the same deck. Between these two houses are the engine room skylight, the muffled scavenge air intake, the expansion chamber and stack for the engine exhaust, and the hatch, winches and king-post derricks of No. 3 cargo hold, these king-posts serving also as ventilators. The deck is laid with teak, 2¾ in. finished thickness and planks 4 in. wide. There is ample space on it for chairs and for walking. Over it an awning can be spread to afford protection from the sun.

In respect to bridge equipment TAMPA is well fitted out. Not only has she a gyro compass, but she has also a gyro-pilot, which is rapidly becoming accepted as a standard fitting on American ships because it steers as well as the best quartermasters and far better than most of them, reducing rudder movements, easing the ship and securing her always better protection because the officer of the watch does not have his attention divided.

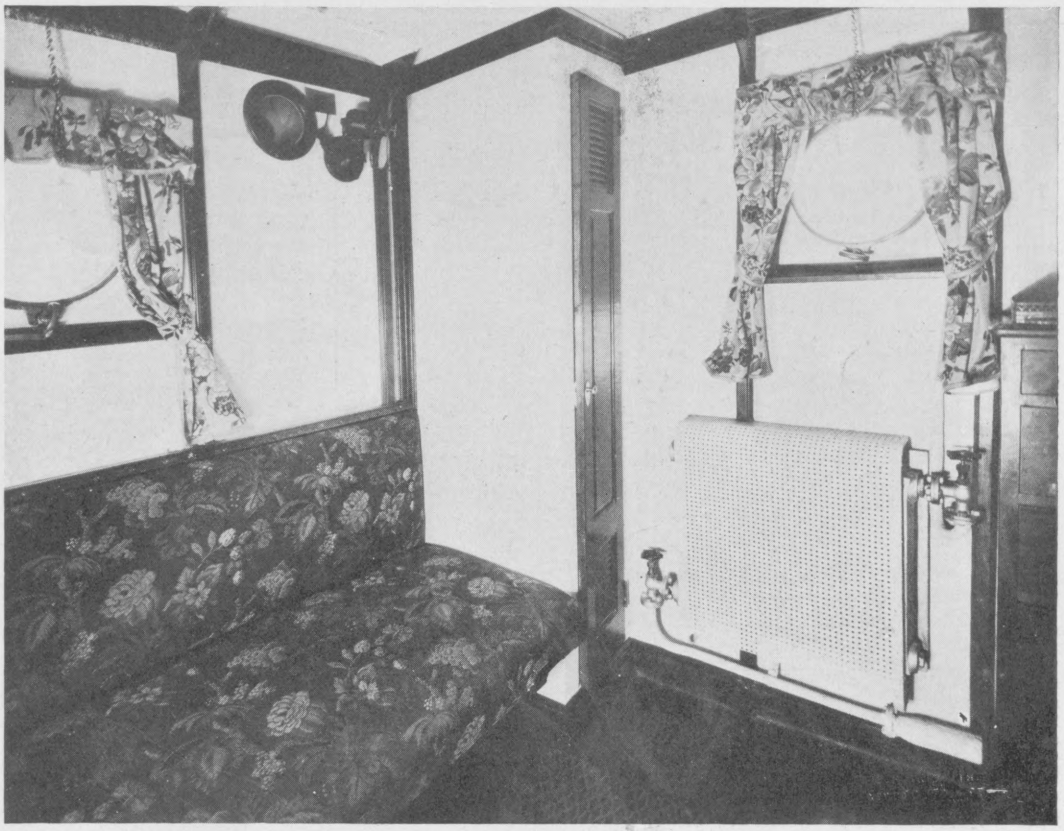
The gyro-pilot is of the Sperry 2-unit type. (See MOTORSHIP, March, 1926) incorporating a new minor feature, namely, a snap switch which gives slower rudder movements under suitable sea conditions. This snap switch merely prevents all the armature resistance being cut out and by reducing the armature current causes slower motion and economizes current.

There is also a further development in the Sperry rudder angle indicator (the term "helm angle indicator" has been abandoned because it led to confusion). This indicator now shows every degree movement of the rudder up to 10 deg. on either side and thereafter every 5 deg.—formerly it showed only every 2½ deg. up to 10 deg. on either side.

Considerable interest attaches to the new Sperry whistle flasher fitted on TAMPA for the first time on any ship. It is an improvement on the Sperry smoke whistle which gives visible indications only in daylight. The new device consists of a powerful light which flashes while the whistle is blown. It is visible at a distance of 2 miles in bright sunshine and at a much greater distance in clear darkness. It is worth recalling that the International Rules for the Prevention of Collision at Sea distinctly approve such a light.

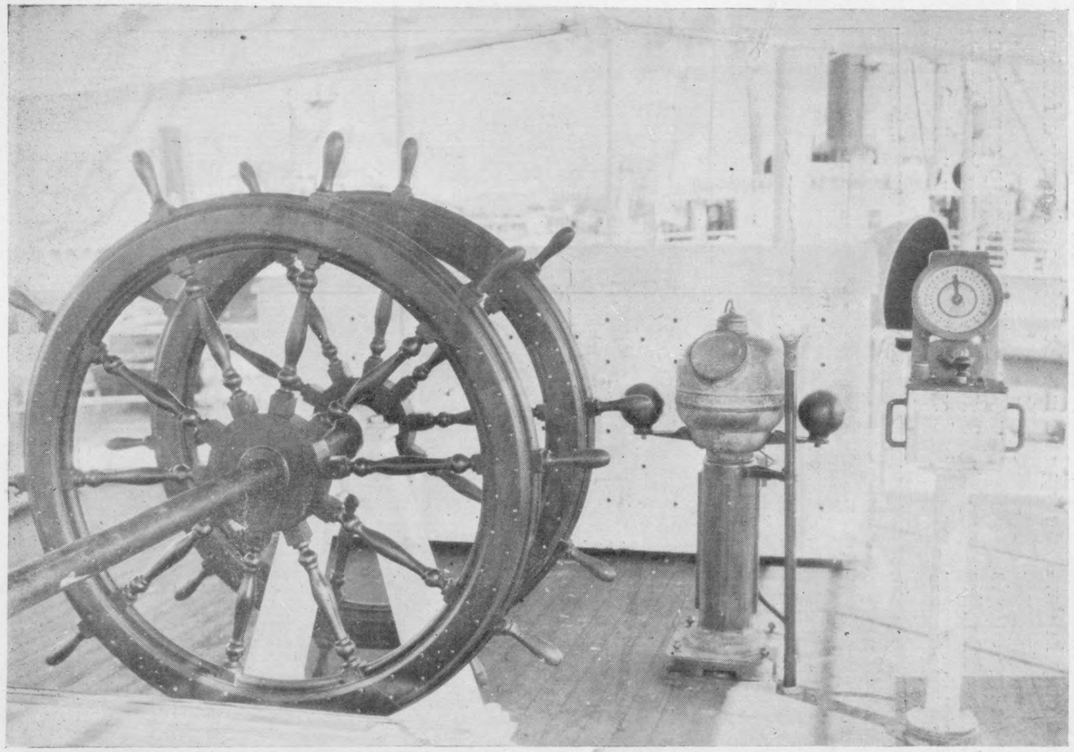
TAMPA'S bridge and navigating equipment are indicative of modern American practice and far ahead of the best practice abroad, so far as freighters are concerned. The bridge of this vessel is indeed better equipped than the bridge of many a foreign passenger liner.

The complement of the ship comprises: captain, 3 officers, radio operator, yeoman or clerk, boatswain, carpenter and 10 sea-

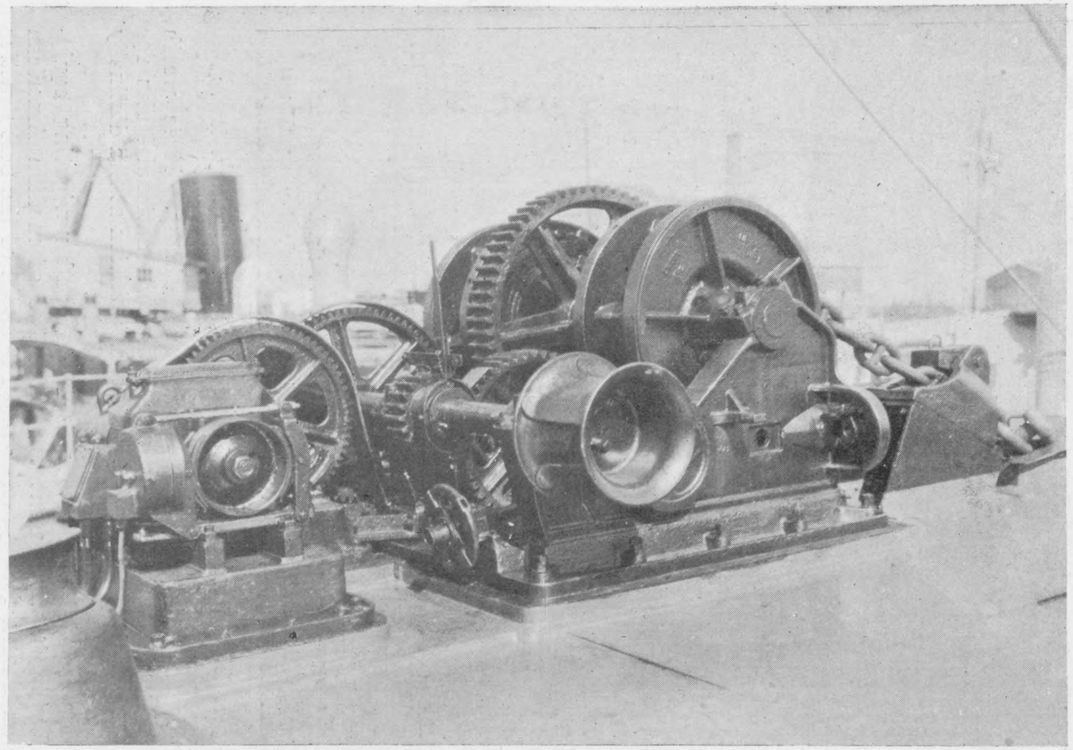


Accommodation for passengers is comparable with that provided on many large liners

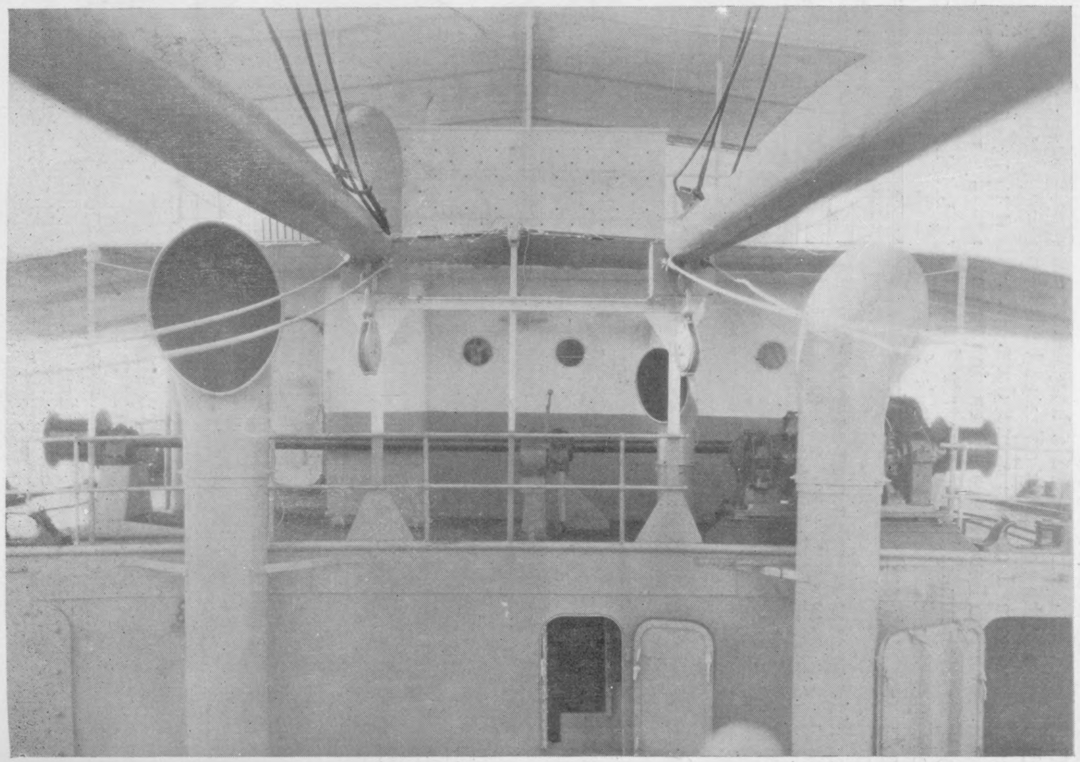
Shipping Board sets a high standard in the arrangement of comfortable crew's quarters



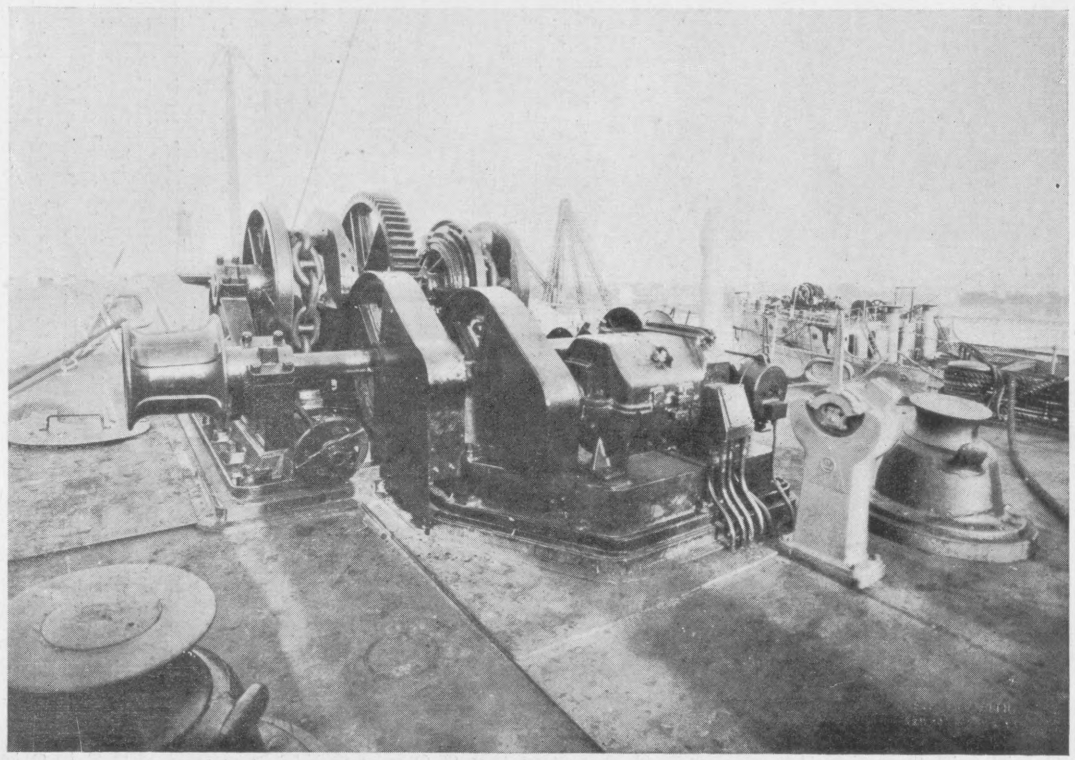
Emergency steering wheel aft makes interesting contrast with stand by rudder controller



Much ingenuity has been shown in adaptation of the original steam winch to electricity



Powerful warping winch on the poop can be used for rudder control in emergency



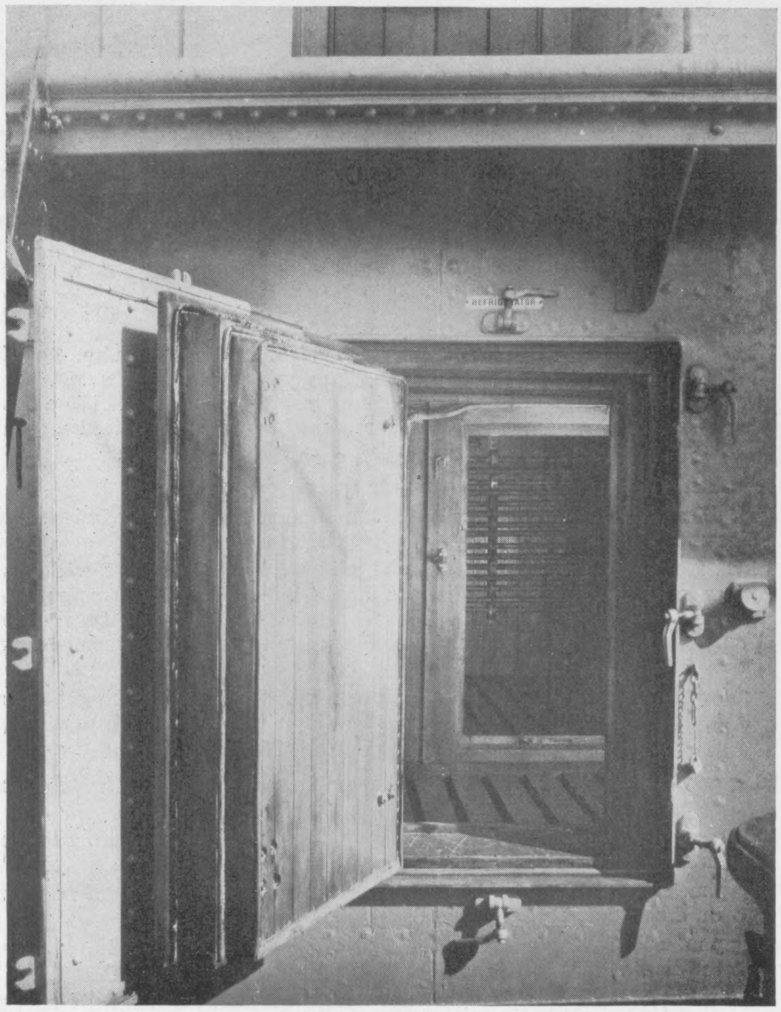
Windlass master controller on forecastle actuates electric controller below through rods

men on deck; chief engineer, 3 assistants, electrical asst. and 6 motormen and wipers below; steward, 2 cooks, 2 messmen and 3 messboys amidships; a total of 37.

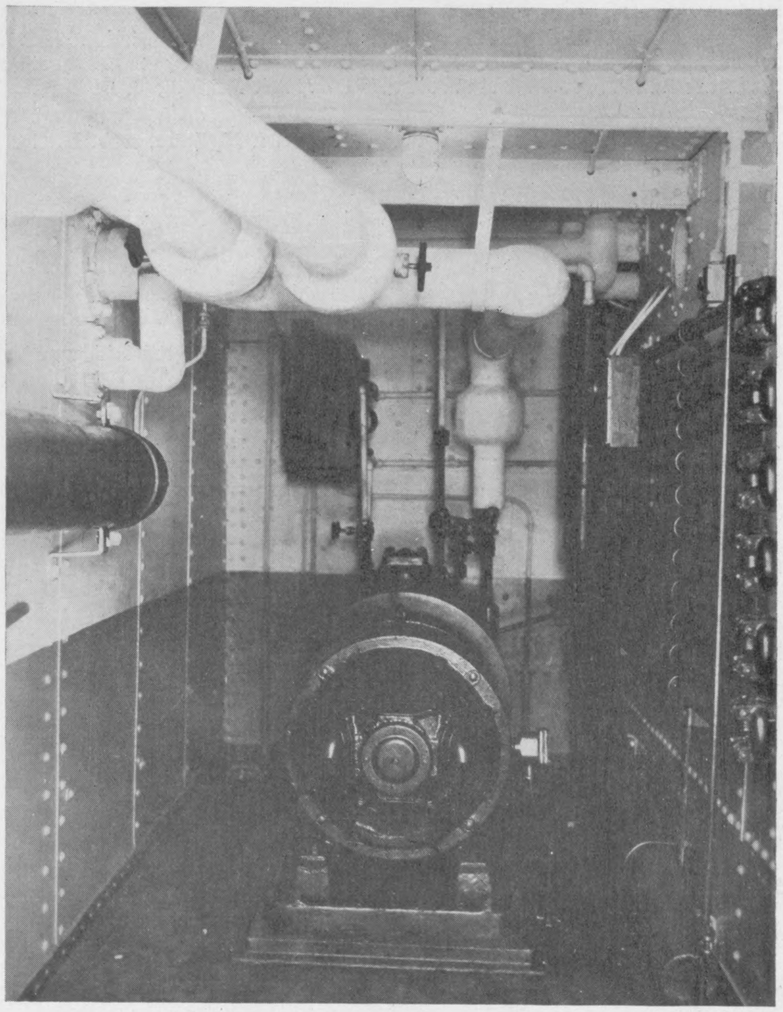
With the 14-knot and 15-knot motor freighters which a few of the leading British lines have lately started to use she has no basis for comparison. Those vessels are for service on highly competitive routes where cargoes comprise many materials of considerable value, on which the interest and insurance charges are high and can be appreciably reduced by cutting down the time at sea. Only between big ports can those vessels run and they must have long passages.

TAMPA'S career is cast in the development of trade routes on which the fast freighter would starve. For her are no precious cargoes nor capacity cargoes from a single port. She is for just such service as those other motorships which Europe buils by the score and which scatter over all the oceans to carry the bulk of the world's freight not as fast, but as cheaply, as it can be carried.

For that prosaic task she is as well fitted as any motorship under any flag, and she can do it under the American flag because she offers high standards of food, housing and comfort and all the help that machinery can give to do a job better and faster and with less toil than it can be done by hand.



Tropical service has been a consideration in the layout of Tampa's cold store—above, the insulated door and watertight door

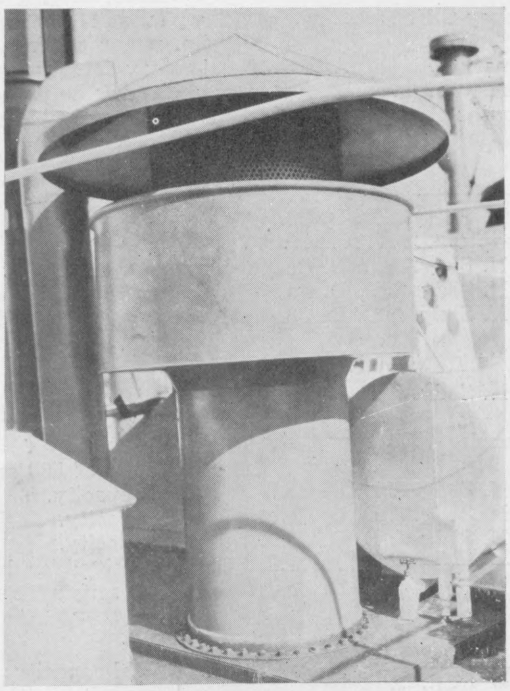


A modern electrical ammonia-type refrigerating machine maintains perishable food at desired temperatures

Old Capacities Questionable

War time measurement errors are brought to light in a comparison of the capacity plans of TAMPA as a steamer and as a motorship. All capacities were remeasured by the Newport News Shipbldg. & Drydock Co., when the vessel was at Newport News for conversion to Diesel power. Double bottom tanks Nos. 1-2-3-5-6 now show a capacity of 760 tons of fuel oil when 95 per cent full; the steamer capacity plans showed exactly 100 tons more of fuel oil in the same tanks; yet the tanks are the same. (The coincidence should be noted that 760 tons of 2240 lb. are about equal to 860 short tons). Cargo hold No. 3 now measures 36,160 cu. ft. bale capacity, compared with 38,063 cu. ft. on the steamer plans, although the capacity of this hold is greater today because the two round settling tanks of 15,300 gal. combined capacity which the steamer had there have been removed.

On the old capacity plans a total of 445,738 cu. ft. was shown and no account taken of the 'tween decks space round the machinery casing. If we allow 1,050 cu. ft. more in that space on the steamer than is now available on the motorship, which has two square f.w. tanks of 8,000 gal. combined capacity there which the steamer did not have, a total of 458,068 cu. ft. bale capacity is obtained for the steamer. This compares with a total of 455,660 cu. ft. credited to the motorship with her increased space in the poop and new space in the fo'c'sle. Compared hold for hold the steamer figures are higher, whereas they should be about equal. Of all the discrepancies between the two sets of measurements the most startling is in the grain capacities, the steamer having had an alleged greater grain capacity of 30,988 cu. ft. The most probable explanation is that the bridge cargo space was included in the grain measurement of the steamer, which should not be done. The steamer's total grain capacity is obviously wrong, and in view of the facts exposed above the entire steamer figures are open to question. What credence should be given to the steamer's deadweight-displacement scale?



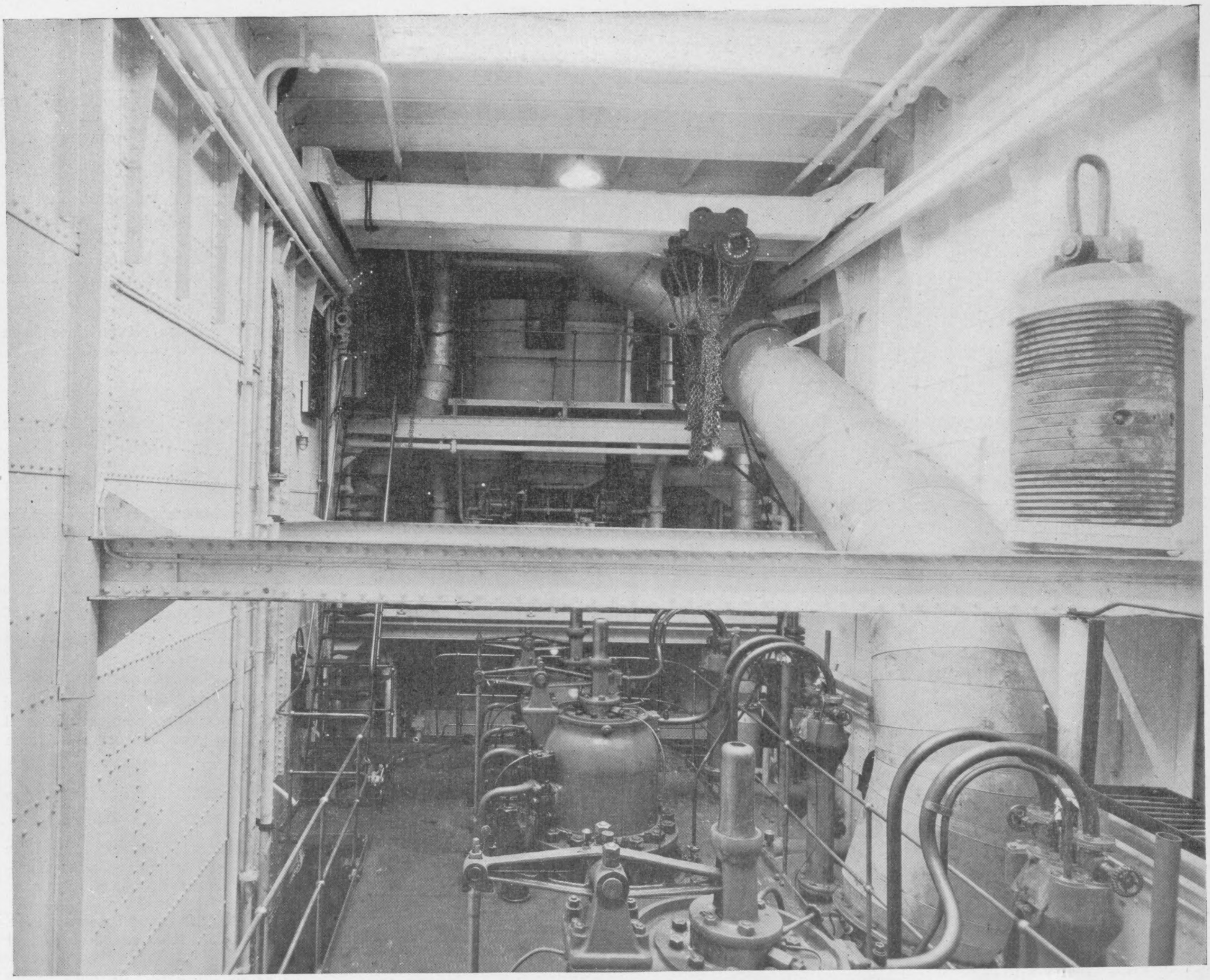
Scavenge air intake on bridge deck

Mechanical and Electrical Appliances in Motorship Tampa, 9120 tons d.w., 2900 b.hp.

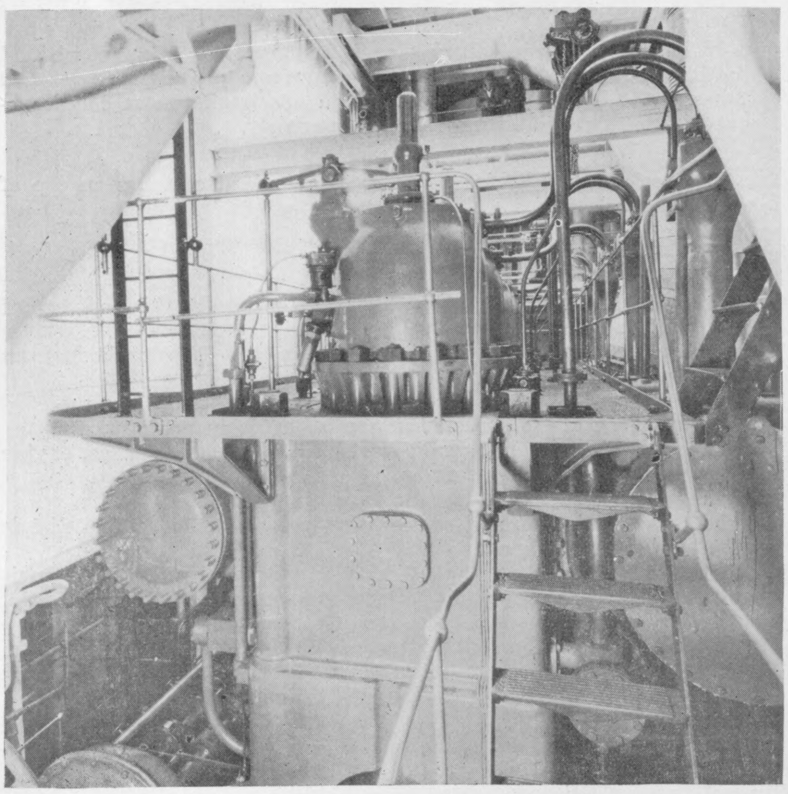
Item	Name of Unit	No. of Units	Make	Description and Characteristics
	Propelling Equipment			
1	Main engine	1	Worthington	2900 b.hp., 2-cycle double-acting, 4 cylinders 28 in. x 40 in., 95 r.p.m., with scavenge pump ratio of 1:1.5 and 4-stage compressor of capacity of 800 cu. ft. of free air per min. to 950 lb. per sq. in.
2	Injection air flask	2	National Tube Co.	17½ cu. ft. capacity each (one service, one reserve).
3	Maneuvering-air tank	2	N. N. Sbdg. & D. D. Co.	550 cu. ft. each, 6 ft. diameter, 20 ft. 8 in. long, working pressure 400 lb. per sq. in.
4	Exhaust line and muffler	1	N. N. Sbdg. & D. D. Co.	30 in. diameter Armco iron built-up pipe lagged with 2½ in. insulation from water cooled manifold on engine to Maxim silencer in stack and 30 in. outlet to atmosphere.
5	Engine water-cooler	1	Griscom-Russell	500 g.p.m., cooling the water for the heads, jackets and pistons.
6	Thrust bearing	1	Kingsbury	32 in. diameter.
7	Shaft	1	N. N. Sbdg. & D. D. Co.	15½ in. diameter thrustshaft, 13¾ in. diameter lineshaft, 15½ in. diameter tailshaft.
8	Stern tube	1	N. N. Sbdg. & D. D. Co.	Original cast iron stern tube relined with lignum vitae and fitted with Bethlehem-McNab-Vista system of lubrication; no liner on tailshaft in way of stern tube, but short sleeve where exposed to salt water.
9	Propeller	1	Amer. Manganese Bronze	4-bladed, built-up, 17 ft. 0 in. diameter, 13 ft. 6 in. pitch, 81.75 sq. in. projected area, 93 sq. in. developed area, 226.98 sq. in. disc area, 0.795 pitch ratio, 0.36 projected ratio, 0.41 developed area ratio; rake of blades 15 in. at tip.
	Auxiliary Power Equipment			
10	Generator and auxiliary compressor set	3	Worthington-Ridgway	75 kw., 240 volt d.c. generator, direct connected with 115 m.hp. 2-cycle single-acting air-injection engine, 3 cylinders 12½ in. x 13¼ in., 265 r.p.m., with 3-stage oversize compressor of capacity of 170 cu. ft. of free air per min. to assist in replenishing main air tanks.
11	Injection air flask	3	National Tube Co.	One to each engine; capacity 2½ cu. ft. each.
12	Starting air tank	—	———	Air taken from main maneuvering-air tanks.
13	Exhaust line and muffler	1	N. N. Sbdg. & D. D. Co.	10 in. diameter Maxim silencer and 10 in. diameter steel pipe, with 2 in. insulation, leading through stack to atmosphere.
14	Port lighting and pilot compressor set	1	Mianus-Diehl-Rix	14 kw., 240 volt d.c. generator, direct connected with 22 b.hp. 2-cycle airless-injection engine, 3 cylinders 5 5/16 in. x 7⅛ in., 550 r.p.m. and direct connected also with Rix air-compressor of capacity of 14½ cu. ft. of free air per min. to 1000 lb. per sq. in. Hand compressor available for starting.
15	Switchboard	1	Walker	4 generator panels, 2 lighting and low power panels, 2 testing panels, 3 duplex motor starting panels and 5 single motor starting panels.
	Pump Equipment			
16	Salt water cooling and general service pump	2	Nash-G.E.	750 g.p.m. at 35 lb. per sq. in., self-priming centrifugal, 8 in. suction, 6 in. discharge, 30 hp. motor.
17	Fresh water cooling pump	1	Nash-G.E.	500 g.p.m. at 55 lb. per sq. in., self-priming centrifugal, 6 in. suction, 6 in. discharge, 30 hp. motor.
18	Fire and bilge pump	1	Nash-G.E.	200 g.p.m. at 100 lb. per sq. in., self-priming centrifugal, 4 in. suction, 3 in. discharge, 20 hp. motor.
19	Engine room bilge pump	1	Nash-G.E.	300 g.p.m. at 20 lb. per sq. in., self-priming centrifugal, 5 in. suction, 4 in. discharge, 7½ hp. motor.
20	Sanitary pump	1	Nash-G.E.	70 g.p.m. at 55 lb. per sq. in., centrifugal, 3 in. suction, 2 in. discharge, 7½ hp. motor.
21	Fresh water pump	1	Nash-G.E.	70 g.p.m. at 55 lb. per sq. in., centrifugal, 3 in. suction, 2 in. discharge, 7½ hp. motor.
22	Lub. oil circulating pump	2	Kinney-G.E.	150 g.p.m. at 35 lb. per sq. in., rotary, 6 in. suction, 6 in. discharge, 7½ hp. motor driving through Falk flexible coupling and reduction gear.
23	Fuel transfer pump	1	Kinney-G.E.	250 g.p.m. at 35 lb. per sq. in., rotary, 6 in. suction, 6 in. discharge, 20 hp. motor driving through Falk coupling and reduction gear.
24	Lub. oil hand pump	1	Rumsey	Semi-rotary force pump, 1¼ in. suction and discharge.
25	Fuel hand pump	1	Rumsey	Semi-rotary force pump, 1¼ in. suction and discharge.
26	Fire hand pump	2	Douglas	6 in. x 5½ in. double-acting force pump, 2½ in. discharge.
	Fuel Oil Service			
27	Storage tanks—double bottom	5	———	760 tons total capacity, fitted with heating coils near pump suctions.
28	Raw fuel oil tank	1	N. N. Sbdg. & D. D. Co.	8½ tons capacity; heating coil 8.7 sq. ft.
29	Fuel oil centrifuge	2	Sharples	Type 6, pressure tight, 300 gal. per hr. with fuel at 210 deg. Fahr.
30	Daily service tank	2	N. N. Sbdg. & D. D. Co.	5 tons capacity each; heating coil 8.7 sq. ft. in each tank.
31	Kerosene oil tank	1	N. N. Sbdg. & D. D. Co.	335 gal. capacity; for emergency starting in extremely cold weather.
32	Catch-all tank	1	N. N. Sbdg. & D. D. Co.	150 gal. capacity; for drains from drip pans.
	Lub. Oil Service			
33	Lub. oil sump tank	2	N. N. Sbdg. & D. D. Co.	4300 gal. total capacity; 4.7 sq. ft. surface of heating coil near pump suction in each tank.
34	Lub. oil purifier	1	Sharples	Type 5A, capacity 20 gal. per hr. of lub. oil at 100 deg. Fahr. with viscosity of 520 secs. Saybolt Univ.
35	Cylinder oil tank	1	N. N. Sbdg. & D. D. Co.	2200 gal. capacity.
36	Compressor oil tank	1	N. N. Sbdg. & D. D. Co.	500 gal. capacity.
37	Piston-rod oil tank	1	N. N. Sbdg. & D. D. Co.	375 gal. capacity.
38	Save-all tank	1	———	60 gal. capacity; for drains from drip pans.
39	Dirty lub. oil tank	1	N. N. Sbdg. & D. D. Co.	145 gal. capacity; for used oil from auxiliary engines for centrifuging.
	Misc. Oil Service			
40	Kerosene oil tank	2	———	120 gal. total capacity; engine room cleaning oil.
41	Galley range tank	1	N. N. Sbdg. & D. D. Co.	165 gal. capacity, with heating coil; gravity tank above galley.

Worthington Double-Acting 2-Cycle Diesel. Converted by Newport News Sb. & D. D. Co.

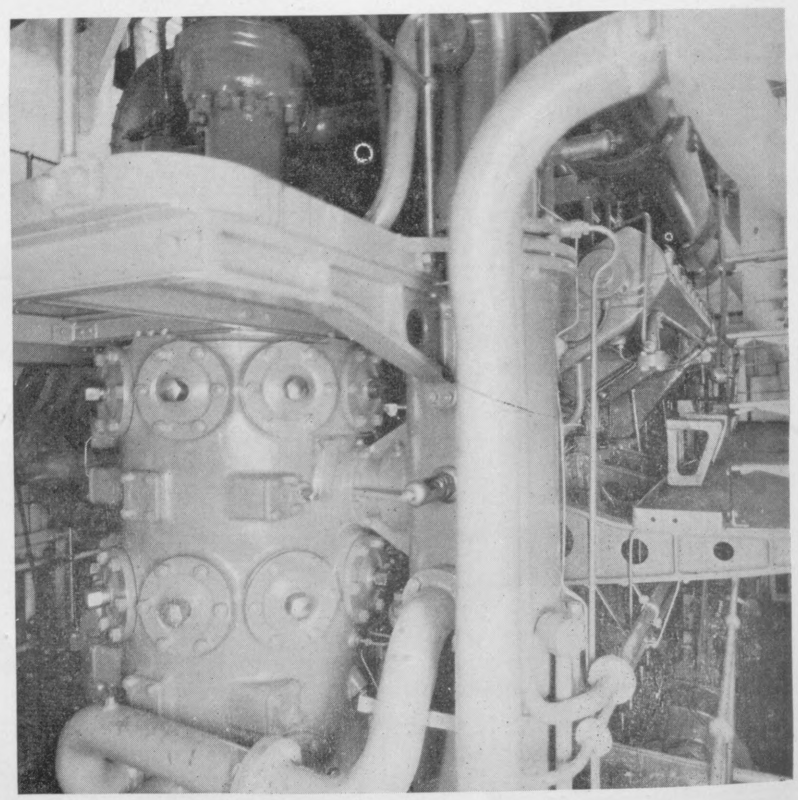
Item	Name of Unit	No. of Units	Make	Description and Characteristics
	Lifting Gear			
42	Traveling crane	1	N. N. Sbdg. & D. D. Co.	Hand operated, with two 4-wheel, 4-tons Yale & Towne combined chain blocks and trolleys, over the main engine.
43	Geared trolley	3	Yale & Towne	4-wheel, 2 tons combined chain block and trolley on I-beam over each generator set.
	Machine Shop			
44	Machine tool	3	See next column	Walcott lathe, Canedy Otto drill press and Meyers grinding wheel stand, with line shafting driven by a 7½ hp. G. E. motor.
	Heating Equipment			
45	Heating boiler	1	N. N. Sbdg. & D. D. Co.	Vertical, 4 ft. 0 in. diameter, 11 ft. 8 in. high, 220 sq. ft. heating surface total, working pressure 110 lb. per sq. in., Coen Sunbeam oil burner.
46	Boiler feed pump	1	Worthington	3 in. x 2 in. x 3 in. horizontal duplex.
47	Hot well tank	1	N. N. Sbdg. & D. D. Co.	156 gal. capacity.
48	Vacuum pump	1	Warren	5½ in. x 8 in. x 7 in. horizontal simplex, for steam return lines from oil tank coils.
49	Evaporator	1	Griscom-Russell	25 tons capacity.
50	Drinking water still	1	Jewell	25 gal. capacity.
51	Hot fresh water tank	1	N. N. Sbdg. & D. D. Co.	100 gal. capacity.
52	Fresh water heater	2	Sepco	One of 3000 watts capacity in hot fresh water tank. One of 1500 watts capacity for shower and basin in crew's washroom.
53	Electric steam radiator	1	Sepco	1000 watts capacity for carpenter shop.
	Refrigerating Service			
54	Ice machine	1	York-Diehl	2-tons capacity, direct expansion ammonia compressor, 2-cylinders 4 in. x 4 in. single-acting, 275 r.p.m., direct connected with 7½ hp. Diehl motor through Clark flexible coupling.
55	Cooling coils	3	York	Meat room 10 deg. F., 687 cu. ft., 353 linear ft. 1¼ in. pipe. Meat room zero deg. F., 732 cu. ft., 593 linear ft. 1¼ in. pipe. Vegetable room 24 deg. Fahr., 490 cu. ft., 224 linear ft. 1¼ in. pipe, all Reading genuine wt. iron pipe.
56	Cork insulation	—	Livezey	Two layers of blocks, each 3 in. thick, on floor; 8 in. layer granulated round sides and 10 in. layer granulated on top.
	Deck & Hold Equipment			
57	Anchor windlass	1	American-Clay-Westinghouse	Original 2 5/16 in. stud link cable windlass converted. Now operated by motor of 45 hp. at 450 r.p.m. with Westinghouse controller and Cutler-Hammer magnetic brake. Extra gear reduction between motor and cable drum.
58	Warping winch	1	Lidgerwood-Westinghouse	Same design and size as cargo winches, with additional reduction gear to extension shaft of winch heads.
59	Cargo winch	10	Lidgerwood-Westinghouse	Maximum lift 10,000 lb., normal rating 4000 lb. at 185 ft. per min. Five right-hand and five left-hand. Geared to 25 hp. motor, with Westinghouse controller and Cutler-Hammer magnetic brake.
60	Cargo boom	11	———	Ten 5-ton steel booms. Length 50 ft. at Nos. 1, 2 and 4 hatches, 29 ft. at No. 3 hatch and 39 ft. at No. 5 hatch. Also one 30-ton steel boom.
61	Steering gear	1	Amer. Eng. Co.-Westinghouse	Original screw steering gear, operated by 25 hp. motor through Cleveland Worm & Gear Co.'s reduction gear unit and Falk flexible coupling. Westinghouse controller regulated by Sperry electric control from bridge.
62	Fire extinguishing system	1	Lux CO_2	Total 82 bottles of 50 lb. capacity each, arranged in 7 banks, with 10 bottles in reserve and one each in lamproom and paintroom. All 7 banks (70 bottles) can be discharged into engine room simultaneously or into cargo compartments separately.
	Navigation Equipment			
63	Magnetic compasses	3	See next column	Hand in wheelhouse; Ritchie (navy type) standard compass on top of wheelhouse; Hand at emergency steering station on top of poop house.
64	Gyro compass	1	Sperry	Mark VIII, Model 2. Repeater at gyro-pilot.
65	Gyro-pilot	1	Sperry	2-unit type. Mark IV, Model 3.
66	Rudder indicator	2	Sperry	One in wheelhouse and one at emergency steering station, on top of poop house.
67	Emergency steering	2	Westinghouse & Amer. Eng. Co.	Electric steering stand with non-follow-up control (Westinghouse) on top of poophouse. Hand steering at same station.
68	Mechanical telegraph	2	McNab-Chadburn	One in wheelhouse and other on bridge; indicator in engine room.
69	Telephone	6	Henschel	To stations in captain's office, radio room, chief engineer's office, engine room and steering engine room.
70	Speaking tube	3	Cory	To engine room, captain's stateroom, gyro compass room.
71	Navigation and signal lights	5	———	Sidelights, masthead light and range light with Russell & Stoll tell-tale panel and portable anchor light.
72	Searchlight	1	Sperry	18-in. incandescent type on top of wheelhouse with control in wheelhouse; fitted with defocussing device to permit use as a floodlight.
73	Radio	1	R. C. A. service	Spark transmitter; Navy type receiver; Crocker-Wheeler generator.
74	Whistle	1	Sperry	8-in. air whistle Tyfon type with attached flashing lamp of 250 watts in Fresnel lens. Working pressure 100 lb. per sq. in., obtained from maneuvering air tanks through Leslie reducing valve.
75	Fire detector	1	Rich	20 detector lines.
76	Submarine signal apparatus	1	Submarine Signal Co.	Receivers in wheelhouse.
77	Patent log	1	Walker Cherub	Works from taffrail aft.
78	Sounding machine	1	Hand	Wire-reel type on starboard side.



General view of engine casing at cylinder top level gives an impression of the compactness and simplicity of the 2900 hp. main Diesel



Looking forward from fuel separator platform



Main engine compressor at fore end of engine

Economics of Ms. Tampa's New Machinery

Show That the Double-Acting 2-Cycle Diesel Is a Prime Mover with a Wide Range of Application

By O. E. Jorgensen*

FOR all those who wish well for the American merchant marine the trial trip of ms. TAMPA was an event of promise and encouragement. It may very conceivably go down in history as the turning point in the battle to keep the American flag on the high seas.

When the TAMPA returned to Hampton Roads from a successful trial run, turned round and proceeded to Savannah for a cargo of cotton, the Shipping Board's motorship program was inaugurated; the first of a fleet of motorships had gone into the American export trade and more than that, the ship that did it represented an American contribution to motorship engineering which puts it on an equal footing with the latest progress in the art anywhere in the world.

The problem confronting the designer of motorship machinery today is radically different from that of the early days of motorship construction. There was no doubt then about the commercial success of a motorship like SELANDIA if it could run as steadily and handle as easily as a steamer. Trading from Europe to the Far East where fuel was cheap, it had an enormous advantage over the steamer burning coal brought out from England; it had the advantage of a great saving of space by using the bottom tanks for fuel oil where the steamer had to carry coal in valuable cargo space; it had a smaller crew, it lost less time in bunkering and it saved weight on the lighter bunkers.

Reliability and Flexibility

The problem was to make the Diesel engine equal to the steam engine in reliability and flexibility. Reliability was secured by adaptation to ship conditions of the well established single-acting 4-cycle stationary Diesel engine; flexibility and easy handling was a question of a suitable starting mechanism concentrating the control of the engine in a single handle requiring the least possible effort to manipulate. On the happy solution of these problems and the conservative m.e.p. rating of the engine rests the success of SELANDIA and the many motorships of the same type which are now in service.

Our problem today is of a different nature. On long voyages the motorship has definitely conquered the steamer; we are now trying to conquer it on all routes and in all powers. The reliability of the motorship is established; there is no doubt about its manoeuvering qualities; its insurance is as cheap as steamer insurance. The motorship is a going concern, but does it pay?

The answer depends on a number of items such as engine cost, weight, space, maintenance, fuel and lubricating oil consumption, cost of fuel oil, number of engine room crew, accessibility of engine parts requiring overhaul, etc. We have, in other words, come down to bed rock in engineering economies and not of the main engine alone, but of the entire ship.

Worthington Pump and Machinery Corporation, the makers of the main engine now installed in TAMPA, have spent years in the development of this engine and have been guided in their endeavor by just these considerations. The double-acting 2-cycle system was selected as the only one which permits a complete utilization of the mechanism as each piston stroke is a power stroke. By cutting out idle strokes, excess weight and cost have been eliminated; the power has been concentrated in a smaller space; the number of parts has been cut down and the maintenance work reduced.

This presentation of the economics of TAMPA'S *double-acting engine has been prepared in response to an invitation extended by* MOTORSHIP *to Mr. Jorgensen, consulting marine engineer to the Worthington Pump & Machinery Corporation. Mr. Jorgensen was chief engineer at Burmeister and Wain in Copenhagen from* 1901 *to* 1912 *and responsible for the design of the Diesel machinery of the motorship* SELANDIA, *historic ship of the East Asiatic Co. which inaugurated the era of the ocean-going motorship. It was during this period he took out the patents on which the Burmeister and Wain starting system is based. From Copenhagen he went to Glasgow to become Managing Director of the Burmeister and Wain Oil Engine Comp., Ltd., to build B. & W. engines under license. When production had been organized and the works in* 1915 *were taken over by Harland & Wolff, Ltd., Mr. Jorgensen returned to Denmark. When the war was over Mr. Jorgensen came to this country, joined the Worthington firm in* 1919, *and in* 1921 *began the development of the double-acting 2-cycle engine which the Worthington Company is now building and which he describes in this article.*

The double-acting cylinder is a combination of two single-acting cylinders placed on a common frame working with a common piston. It was fully realized that no advantage in cost, weight and space would compensate for loss of reliability or increased danger of cylinder failure. On the contrary, it was believed that some extra expense was warranted if the possibility of cylinder cracking could be entirely eliminated. For this reason, the cylinders are made of forged steel, following steam boiler practice which long ago rejected cast iron for parts exposed to flame. The upper part of the cylinder where the combustion takes place consists of this steel shell in single thickness shaped so as to enable it to resist the gas pressure without the use of stays or braces of any kind, presenting to the flame a smooth surface without exposed points of attack, therefore without local heat stresses. Where the piston rings work, this steel shell is lined with cast iron and the whole cylinder is fastened to a cylinder base, common for a top and a bottom cylinder, at its cold end by means of a clamping ring. This ring rests on a shoulder on the steel shell giving the upper heated part of the cylinder full freedom to expand, reducing heat stresses to such a small fraction of the strength of the steel that the margin of safety found in these cylinders is equal to that of all other parts of the machinery.

Similar precautions have been taken in the construction of the piston which is a combination of two single-acting water-cooled pistons with forged steel crowns placed on the common piston rod.

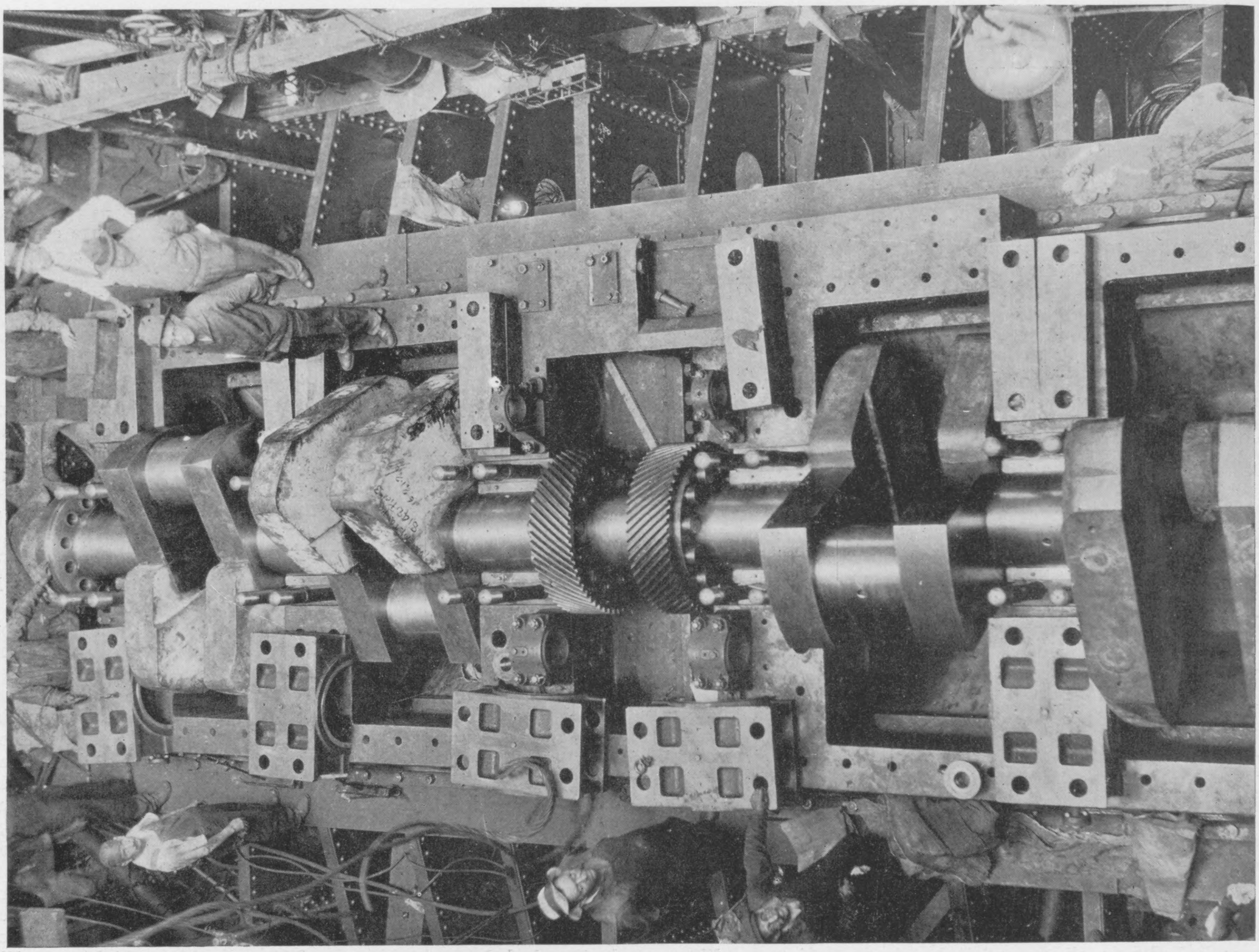
Realizing the importance of small liner wear and lubricating oil economy special care has been taken to secure efficient cooling of the cylinder surface behind the liner, cooling the lubricating oil film on which the piston rings slide, and in uniform distribution of the lubricating oil over the entire liner surface by introduction of the oil from the Manzel timed feed lubricators through eight holes in the middle of each cylinder. The lubricating oil consumption in the cylinders during the 30 days shop test was 3.19 gallons per 24 hours. The liner wear is as small as in any single-acting Diesel engine of equal power.

Air Injection of Fuel

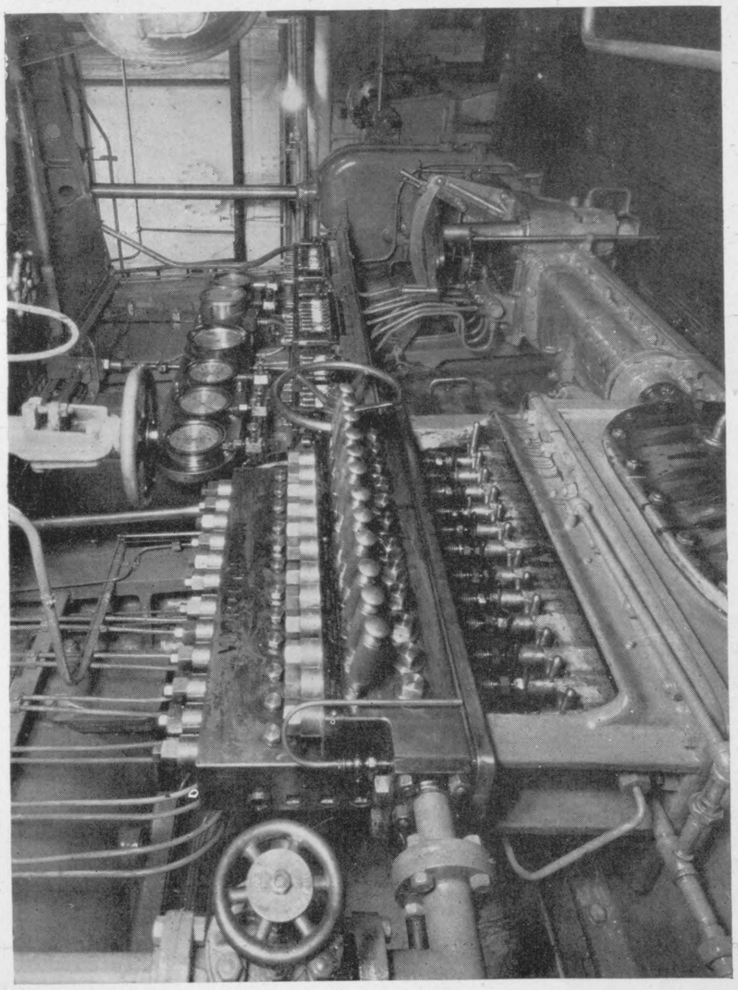
Fuel is injected by means of air; one valve is used in each top cylinder, two in each bottom cylinder and each valve has its own fuel oil pump all of which are combined in a single unit conveniently placed on the manoeuvering platform within easy reach of the engineer. The fuel oil consumption found during the test in the shop was 0.473 lb. per b.hp. in the first engine and 0.446 lb. in the second engine. Part of the difference between these figures is probably due to the fact that the first test was run with cooling water of 34 deg. Fahr. whereas the temperature in the second test was raised to 73 deg. Fahr. The fuel oil used was a heavy oil 20 deg. Beaumé which had to be heated to around 90 deg. Fahr. in order to be serviceable, but even then the fuel economy is not entirely satisfactory and further work will be done in future engines to bring it down to 0.42 lb. per b.hp. The writer is confident that this can be accomplished when full attention can be given to the problem which in this first engine was considered a secondary matter.

In the statics of the general engine design it was considered important to clearly define the run of the forces and avoid any combination of adjacent cylinders which might set up secondary stresses tending to distort the cylinders and produce liner scoring and wear in which respect this

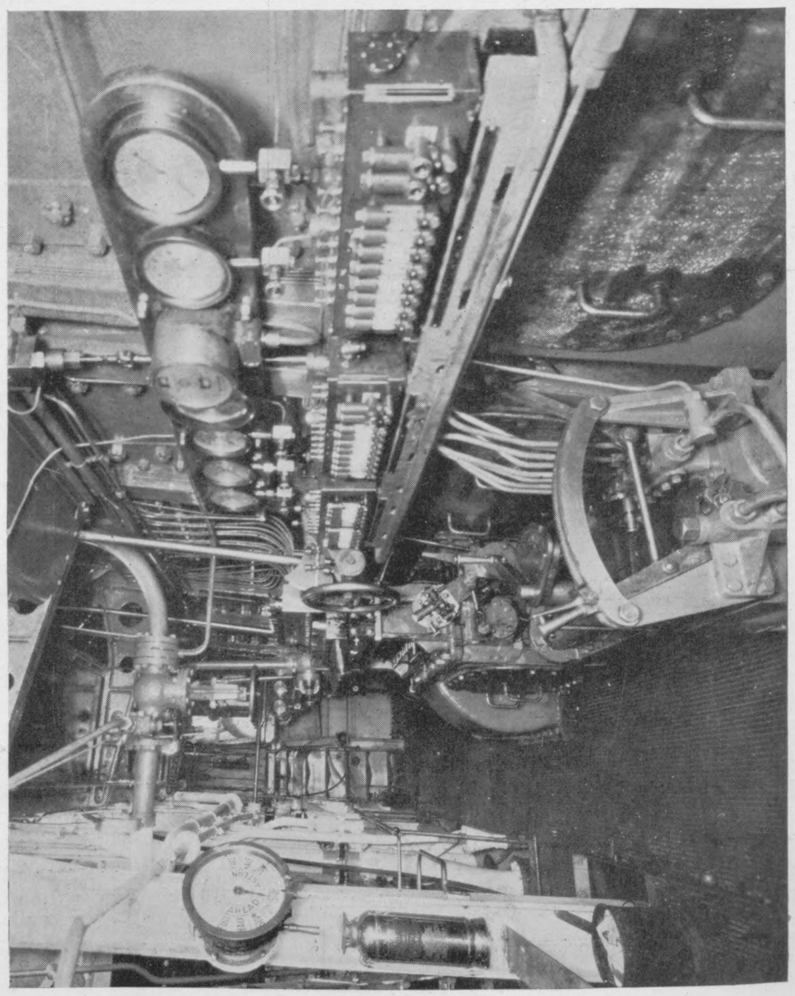
*Consulting Marine Engineer Worthington Pump & Machinery Corporation.



Tampa's main engine bedplate is supported on specially constructed girders attached to tank top



Close up of control position shows accessibility of lubricators fuel pumps



Control station is arranged conveniently on port side of engine

engine has a clean record. Consequently each working cylinder has its own frame connected to the adjacent frame only at its lower part so as to make the crankcase common for all cylinders. Each cylinder is held down to the bedplate by four bolts serving only that cylinder. By this arrangement the engine has little tendency to resist the unavoidable movement of hull members produced by pitching and rolling, but rather the engine will follow the ship without being exposed to extra stresses which in many rigid engines have proved troublesome. Each main frame is of box section with solid heavily ribbed sides to provide lateral stiffness, but open at the front side to give access to the machinery. This opening is closed during operation by a large aluminum door in two halves operable by one man. Aluminum is used for convenience in other parts which have to be removed for overhaul, a silicon alloy of it, which resists attack of sea water being used.

Considerable study was spent on the design of the valve motion before the desired simplicity was attained. The difficulty consists in the separation of the valves of the top and bottom cylinders, the sloping position of the bottom spray valves and the reversing mechanism required for spray valves as well as of starting valves. The present simple arrangement was obtained by appreciation of the difference in the nature of operation of these two kinds of valves.

Account was taken of the fact that the spray valves work all of the time, the starting valves working quite intermittently and doing their work for a very limited number of revolutions even if the entire life of the engine is considered. This difference has been reflected in the method of actuating the two kinds of valves as follows: The spray valves are operated by individual cams and push or pull rods as the valve location required; the starting valves are actuated by compressed air reducing their reversible valve motion to that of their pilot valves. The reversing of the spray valves is effected by a suitable angular displacement of the camshaft in relation to the crankshaft which permits the same cam to function for both ahead and astern running. This displacement is obtained in a positive way by the use of a layshaft interposed between the driving spur gears on the crankshaft and the vertical shaft driving the camshaft. This layshaft has a longitudinal motion under control of a simple Brown gear, and as the driving gear wheels have diagonal teeth it is forced to rotate at the same time as it slides in its own direction thereby reversing the spray valve cams. At the same time the reversing of the starting pilot valves has been taken care of as their cams are placed on the layshaft. Either the ahead or the astern cams are in a position to actuate these small valves. As the layshaft also drives the fuel oil pumps it is quite a useful detail in the machinery.

Maneuvering of the engine is concentrated in two handles, one of which controls the Brown gear setting the valve motion for ahead or astern motion, and the other the starting, changes in load and stopping of the engine. Manipulation of the starting handle is particularly easy in this engine because the valve which admits air to the pilot valve system and thereby starts the engine, or interrupts this supply and thereby makes the starting valve inoperative, is quite a small unit operating in ball bearings. The starting handle also controls the fuel oil pumps and admits fuel oil to the spray valves at the same time as the starting valves go out of action. The engine starts usually after one half to one full revolution on air; it has been tested that TAMPA has air storage capacity enough for 80 starts and reversals without replenishing its tanks.

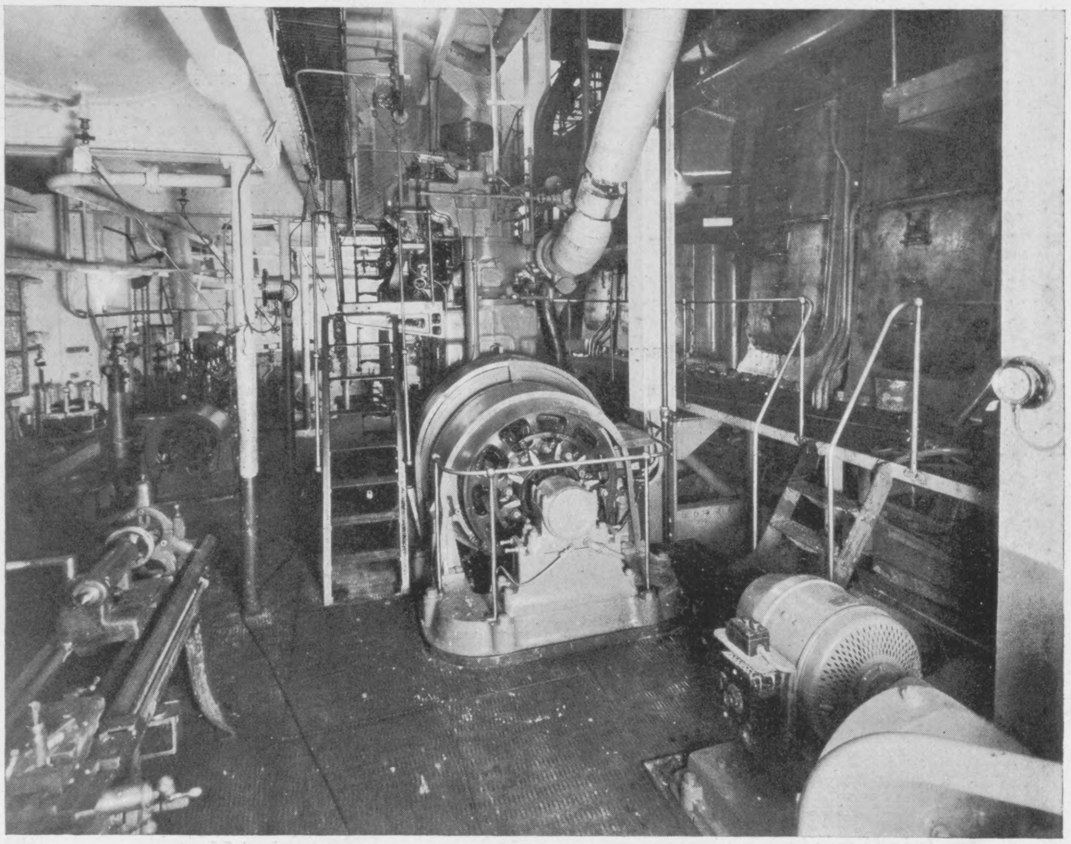
Being of the crosshead type and having the cylinders entirely separated from the crankcase, this engine is free from contamination of the crankcase oil by black oil from the cylinders. The immediate result is that the circulating oil stays clean and clear and permits the extension of forced feed lubrication by the same body of oil to all important bearings of the engine, including the camshaft, the fulcrums for the valve levers, the fuel oil pump mechanism, and the reversing gear. This reduces to a minimum the manual work in caring for the engine, and the result in the long run will be only slight wear on all these bearings, it being easy to eliminate particles and possible water from the oil by occasional centrifuging, whereas carbon contamination cannot be easily overcome.

The scavenge pump has two cylinders in tandem and is geared up to double engine speed for reduction of weight and space; this arrangement has the further advantage that the pump discharges its air at the same rate at which it is absorbed by the engine, leaving the pressure in the scavenge air manifold nearly constant. The flow of air through the compressor is regulated by a revolving valve chain-driven from the camshaft and the loss of pressure is thereby reduced to ¼ lb. during the suction and the discharge stroke resulting in high efficiency for this auxiliary.

The spray air compressor has four stages, the first of which is double-acting to reduce the dimensions of the compressor. Its capacity is ample for the engine's requirements leaving a large surplus for starting purposes and for slow speed operation. The objection to such a surplus capacity is reduced by the four stages, as the pressure at which the surplus is blown off is low.

Considerable attention has been given to accessibility of all parts requiring overhaul as this is such an important factor in maintenance economy. Dismantling of parts which are in the way, but have nothing to do with the part requiring overhaul is wasteful and in this engine has practically been eliminated.

The condition of the piston rings can be observed through the air ports from the scavenge air manifold. The piston is lifted out through the top after removal of the cylinder top and the two parts can be placed on the top platform between the adjacent pair of cylinders where it is reinforced for this purpose. With shop facilities a piston can be lifted out in 90 min. by four men; in the ship the time required is somewhat longer. The telescopic pipes of the piston cooling system are placed outside the engine and can be removed without any extra dismantling. The fuel valves are easily accessible from platforms at suitable heights and can be lifted by two men without tackle.



General view of starboard side of engine room shows small space absorbed by Diesel layout

Arrangements are made so that the starting valves can be worked while the engine is in operation, in order to make sure that they do not stick when called upon to work. All valves on the air compressor are within easy reach from the two platforms and any valve can be overhauled by removal of its separate cover.

The piston rod packing can be reached through the crankcase after dismantling of the top plate in the frame through which the piston rod travels. This top plate is cast of aluminum in two halves and easily removable.

Any fuel oil pump can be set out of action by the simple lifting of the valve lifting spindle by hand and be put back into

30-Day Full Load Test on First Worthington 4-Cylinder, 28 in. x 40 in., Double-Acting 2-Cycle Diesel

	Item	Maximum Reading	Minimum Reading	Average Reading
1	Load	100 per cent	100 per cent	100 per cent
2	Barometer	29.55 in.	28.42 in.	29.06 in.
3	Duration	30 days	30 days	30 days
	Pressures			
4	Injection air	890.0 lb. per sq. in.	883.5 lb. per sq. in.	889.0 lb. per sq. in.
5	Jacket cooling water	31.2 lb. per sq. in.	29.8 lb. per sq. in.	30.3 lb. per sq. in.
6	Piston cooling water	31.2 lb. per sq. in.	29.8 lb. per sq. in.	30.3 lb. per sq. in.
7	Lubricating oil	12.0 lb. per sq. in.	12.0 lb. per sq. in.	12.0 lb. per sq. in.
8	Scavenge air	1.75 lb. per sq. in.	1.5 lb. per sq. in.	1.6 lb. per sq. in.
	Temperatures			
9	Atmosphere	43.7 deg. Fahr.	20.2 deg. Fahr.	29.3 deg. Fahr.
10	Engine room	72.4 deg. Fahr.	63.1 deg. Fahr.	67.9 deg. Fahr.
11	Fuel oil	92.4 deg. Fahr.	86.2 deg. Fahr.	88.6 deg. Fahr.
12	Cooling water inlet	42.0 deg. Fahr.	38.7 deg. Fahr.	39.4 deg. Fahr.
13	Cooling water outlet	117.0 deg. Fahr.	108.0 deg. Fahr.	116.4 deg. Fahr.
14	Exhaust	551.5 deg. Fahr.	470.0 deg. Fahr.	548.1 deg. Fahr.
	Fuel Analysis			
15	High heat value	19,013 B.t.u.	18,960 B.t.u.	19,002 B.t.u.
16	Low heat value	17,980 B.t.u.	17,900 B.t.u.	17,917 B.t.u.
17	Beaumé gravity	21.3 deg.	19.3 deg.	20.3 deg.
18	Saybolt Furol (at 77 deg. Fahr.)	70 sec.	62 sec.	67.2 sec.
19	Sulphur content	0.43 per cent	0.38 per cent	0.40 per cent
20	Flash (Pensky-Martens)	——	——	182 deg. Fahr.
21	Burning point	——	——	273 deg. Fahr.
	Fuel Consumption			
22	Lb. per hr.	1439 lb.	1316 lb.	1427 lb.
23	Lb. per i.hp.-hr.	0.36 lb.	0.336 lb.	0.363 lb.
24	Lb. per bhp.-hr.*	0.48 lb.	0.464 lb.	0.473 lb.
	Power and Efficiency			
25	Engine speed	98.0 r.p.m.	95.2 r.p.m.	95.4 r.p.m.
26	I.hp. power cylinders	4232 i.hp.	3937 i.hp.	4038 i.hp.
27	M.i.p.	91.2 lb. per sq. in.	85.0 lb. per sq. in.	89.5 lb. per sq. in.
28	M.e.p. (calculated)	65.3 lb. per sq. in.	59.5 lb. per sq. in.	64.8 lb. per sq. in.
29	I.hp.† scavenge pumps	192.9 i.hp.	181.1 i.hp.	182.2 i.hp.
30	I.hp.† compressor	202.8 i.hp.	169.9 i.hp.	187.3 i.hp.
31	Brake horsepower	2947 b.hp.	2756 b.hp.‡	2927 b.hp.
32	Mechanical efficiency	73.1 per cent	68.3 per cent	72.5 per cent
33	Thermal efficiency	29.7 per cent	28.7 per cent	29.0 per cent

Shop Tests on Second Worthington 4-Cylinder, 28 in. x 40 in., Double-Acting 2-Cycle Diesel

	Item	Full Ahead Test Reading	Overload Test Reading	Full Astern Test Reading
1	Load	100 per cent	115 per cent	100 per cent
2	Barometer	——	——	——
3	Duration of test	24 hr.	6 hr.	1 hr.
	Pressures			
4	Injection air	878.2 lb. per sq. in.	976.6 lb. per sq. in.	895.0 lb. per sq. in.
5	Jacket cooling water	27.4 lb. per sq. in.	31.0 lb. per sq. in.	30.0 lb. per sq. in.
6	Piston cooling water	27.4 lb. per sq. in.	31.0 lb. per sq. in.	30.0 lb. per sq. in.
7	Lubricating oil	12.0 lb. per sq. in.	12.0 lb. per sq. in.	12.0 lb. per sq. in.
8	Scavenge air	1.6 lb. per sq. in.	1.8 lb. per sq. in.	1.6 lb. per sq. in.
	Temperatures			
9	Atmosphere	54.8 deg. Fahr.	62.6 deg. Fahr.	62.0 deg. Fahr.
10	Engine room	73.6 deg. Fahr.	77.7 deg. Fahr.	80.0 deg. Fahr.
11	Fuel oil	89.8 deg. Fahr.	92.0 deg. Fahr.	92.0 deg. Fahr.
12	Cooling water inlet	79.7 deg. Fahr.	80.0 deg. Fahr.	72.0 deg. Fahr.
13	Cooling water outlet	120.3 deg. Fahr.	122.5 deg. Fahr.	112.6 deg. Fahr.
14	Exhaust	513.3 deg. Fahr.	598.6 deg. Fahr.	513.8 deg. Fahr.
	Fuel Analysis			
15	High heat value	19,002 B.t.u.	19,002 B.t.u.	19,002 B.t.u.
16	Low heat value	17,917 B.t.u.	17,917 B.t.u.	17,917 B.t.u.
17	Beaumé gravity	21.3 deg.	21.3 deg.	21.3 deg.
18	Saybolt Furol (at 77 deg. Fahr.)	62 sec.	62 sec.	62 sec.
19	Sulphur content	40 per cent	40 per cent	40 per cent
20	Flash (Pensky-Martens)	182 deg. Fahr.	182 deg. Fahr.	182 deg. Fahr.
21	Burning point	273 deg. Fahr.	273 deg. Fahr.	273 deg. Fahr.
	Fuel Consumption			
22	Lb. per hr.	1340 lb.	1575 lb.	1337 lb.
23	Lb. per i.hp.-hr.	0.317 lb.	0.326 lb.	——
24	Lb. per b.hp.-hr.*	0.446 lb.	0.450 lb.	0.451 lb.
	Power and Efficiency			
25	Engine speed	95.3 r.p.m.	100.7 r.p.m.	95.5 r.p.m.
26	I.hp. power cylinders	4095 i.hp.	4671 i.hp.	——
27	M.i.p.	90.9 lb. per sq. in.	98.5 lb. per sq. in.	——
28	M.e.p. (calculated)	66.6 lb. per sq. in.	71.5 lb. per sq. in.	——
29	I.hp.† scavenge pumps	187.9 i.hp.	212.8 i.hp.	——
30	I.hp.† compressor	180.7 i.hp.	203.3 i.hp.	——
31	Brake horsepower	2912 b.hp.	3390 b.hp.	2862 b.hp.
32	Mechanical efficiency	71.1 per cent	72.6 per cent	....
33	Thermal efficiency	30.8 per cent	30.5 per cent	30.5 per cent

* Corrected to 18,500 B.t.u. † Subtract.

Varying Load Tests on First Worthington 4-Cylinder, 28 in. x 40 in., Double-Acting 2-Cycle Diesel

	Item	Overload Test Reading	5 Per Cent Overspeed Reading	Part Load Test Reading
1	Load	110 per cent	110 per cent	75 per cent
2	Barometer	29.34 in.	29.46 in.	29.58 in.
3	Duration of test	6 hr.	4 hr.	6 hr.
	Pressures			
4	Injection air	915.0 lb. per sq. in.	922.5 lb. per sq. in.	800.0 lb. per sq. in.
5	Jacket cooling water	31.0 lb. per sq. in.	31.0 lb. per sq. in.	25.0 lb. per sq. in.
6	Piston cooling water	31.0 lb. per sq. in.	32.0 lb. per sq. in.	25.0 lb. per sq. in.
7	Lubricating oil	12.3 lb. per sq. in.	12.0 lb. per sq. in.	11.0 lb. per sq. in.
8	Scavenge air	1.8 lb. per sq. in.	2.0 lb. per sq. in.	1.4 lb. per sq. in.
	Temperatures			
9	Atmosphere	18.3 deg. Fahr.	16.0 deg. Fahr.	13.5 deg. Fahr.
10	Engine room	67.2 deg. Fahr.	63.8 deg. Fahr.	61.3 deg. Fahr.
11	Fuel oil	88.6 deg. Fahr.	82.7 deg. Fahr.	83.5 deg. Fahr.
12	Cooling water inlet	38.7 deg. Fahr.	39.0 deg. Fahr.	39.0 deg. Fahr.
13	Cooling water outlet	124.5 deg. Fahr.	122.5 deg. Fahr.	115.3 deg. Fahr.
14	Exhaust	605.4 deg. Fahr.	601.3 deg. Fahr.	425.4 deg. Fahr.
	Fuel Analysis			
15	High heat value	18,975 B.t.u.	18,975 B.t.u.	18,975 B.t.u.
16	Low heat value	17,941 B.t.u.	17,941 B.t.u.	17,941 B.t.u.
17	Beaumé gravity	20.3 deg.	20.3 deg.	20.3 deg.
18	Saybolt Furol (at 77 deg. Fahr.)	67.2 sec.	67.2 sec.	67.2 sec.
19	Sulphur content	0.4 per cent	0.4 per cent	0.4 per cent
20	Flash (Pensky-Martens)	182 deg. Fahr.	182 deg. Fahr.	182 deg. Fahr.
21	Burning point	273 deg. Fahr.	273 deg. Fahr.	273 deg. Fahr.
	Fuel Consumption			
22	Lb. per hr.	1642 lb.	1688 lb.	1033 lb.
23	Lb. per i.hp.-hr.	0.342 lb.	0.346 lb.	0.302 lb.
24	Lb. per b.hp.-hr.*	0.482 lb.	0.479 lb.	0.450 lb.
	Power Efficiency			
25	Engine speed	95.2 r.p.m.	98.7 r.p.m.	86.4 r.p.m.
26	I.hp. power cylinders	4601 i.hp.	4735 i.hp.	3312 i.hp
27	M.i.p.	102.2 lb. per sq. in.	100.7 lb. per sq. in.	80.5 lb. per sq. in.
28	M.e.p. (calculated)	72.6 lb. per sq. in.	72.6 lb. per sq. in.	54.2 lb. per sq. in.
29	I.hp.† scavenge pumps	193.0 i.hp.	223.9 i.hp.	140.2 i.hp.
30	I.hp.† compressor	195.8 i.hp.	196.2 i.hp.	163.2 i.hp.
31	BRAKE HORSEPOWER	3269 b.hp.	3416 b.hp.	2226 b.hp.
32	Mechanical efficiency	71.0 per cent	72.1 per cent	67.2 per cent
33	Thermal efficiency	28.5 per cent	28.7 per cent	30.5 per cent

Varying Load Tests on First Worthington 4-Cylinder, 28 in. x 40 in., Double-Acting 2-Cycle Diesel

	Item	Half Load Test Reading	Quarter Load Test Reading	Full Astern Test Reading
1	Load	50 per cent	25 per cent	100 per cent
2	Barometer	29.58 in.	29.58 in.	29.58 in.
3	Duration	4 hr.	2 hr.	1 hr.
	Pressures			
4	Injection air	725.0 lb. per sq. in.	692.5 lb. per sq. in.	890.0 lb. per sq. in.
5	Jacket cooling water	25.1 lb. per sq. in.	22.0 lb. per sq. in.	32.0 lb. per sq. in.
6	Piston cooling water	25.1 lb. per sq. in.	22.0 lb. per sq. in.	32.0 lb. per sq. in.
7	Lubricating oil	12.5 lb. per sq. in.	11.0 lb. per sq. in.	12.0 lb. per sq. in.
8	Scavenge air	1.6 lb. per sq. in.	0.75 lb. per sq. in.	1.64 lb. per sq. in.
	Temperatures			
9	Atmosphere	18.5 deg. Fahr.	24.0 deg. Fahr.	18.0 deg. Fahr.
10	Engine room	64.3 deg. Fahr.	69.0 deg. Fahr.	67.0 deg. Fahr.
11	Fuel oil	87.0 deg. Fahr.	84.3 deg. Fahr.	88.5 deg. Fahr.
12	Cooling water inlet	39.0 deg. Fahr.	56.5 deg. Fahr.	39.0 deg. Fahr.
13	Cooling water outlet	112.0 deg. Fahr.	111.9 deg. Fahr.	116.7 deg. Fahr.
14	Exhaust	308.2 deg. Fahr.	240.0 deg. Fahr.	577.5 deg. Fahr.
	Fuel Analysis			
15	High heat value	18,975 B.t.u.	18,975 B.t.u.	189.7 B.t.u.
16	Low heat value	17,941 B.t.u.	17,941 B.t.u.	179.4 B.t.u.
17	Beaumé gravity	20.3 deg.	20.3 deg.	20.3 deg.
18	Saybolt Furol (at 77 deg. Fahr.)	67.2 sec.	67.2 sec.	67.2 sec.
19	Sulphur content	0.4 per cent	0.4 per cent	0.4 per cent
20	Flash (Pensky-Martens)	182 deg. Fard	182 deg. Fahr.	182 deg. Fahr.
21	Burning point	273 deg. Fahr.	273 deg. Fahr.	273 deg. Fahr.
	Fuel Consumption			
23	Lb. per i.hp.-hr.	673.3 lb.	419.5 lb.	1408 lb.
24	Lb. per b.hp.-hr.*	0.295 lb.	0.284 lb.	——
24	Lb. per b.hp. hr.	0.465 lb.	0.525 lb.	0.470 lb.
	Power Efficiency			
25	Engine speed	76.2 r.p.m.	61.6 r.p.m.	95.9 r.p.m.
26	I.hp. power cylinders	2209 i.hp.	1433 i.hp.	——
27	M.i.p.	60.8 lb. per sq in.	49.0 lb. per sq. in.	——
28	M.e.p. (calculated)	38.7 lb. per sq. in.	26.5 lb. per sq. in.	——
29	I.hp.† scavenge pumps	96.1 i.hp.	28.9 i.hp.	——
30	I.hp.† compressor	158.4 i.hp.	124.1 i.hp.	——
31	BRAKE HORSEPOWER	1407 b.hp.	775 b.hp.	2902 b.hp.
32	Mechanical efficiency	63.7 per cent	54.1 per cent	——
33	Thermal efficiency	29.6 per cent	26.2 per cent	29.2 per cent

* Corrected to 18,500 B.t.u. † Subtract.

Wear on Moving Parts of First Worthington 4-Cylinder Double-Acting 2-Cycle Diesel Engine

Wear on Power Cylinders

Top Cylinders	No. 1	No. 2	No. 3	No. 4
Maximum	.0105 in.	.014 in.	.012 in.	.012 in.
Minimum	nil	.002 in.	.001 in.	.003 in.
Average	.0045 in.	.005 in.	.004 in.	.006 in.

Bottom Cylinders	No. 1	No. 2	No. 3	No. 4
Maximum	.0140 in.	.011 in.	.010 in.	.015 in.
Minimum	.0020 in.	.015 in.	.001 in.	.003 in.
Average	.0065 in.	.005 in.	.006 in.	.007 in.

Liners were measured at six equally divided points of the piston ring travel. Four radial measurements were taken at each point. The average represents the mean of four measurements after the engine had operated 52 days under full load.

Wear on Piston Rods

	No. 1	No. 2	No. 3	No. 4
Maximum	.002 in.	.002 in.	.002 in.	.002 in.
Minimum	.001 in.	.001 in.	.001 in.	.001 in.
Average	.001 in.	.001 in.	.001 in.	.001 in.

Rods were measured at 5 in. spacings. Two radial measurements were taken at each point. The average wear represents the mean of 28 measurements after the engine had operated 52 days under full load.

"Growth" in Cylinder Liners

Top Cylinders	No. 1	No. 2	No. 3	No. 4
Maximun	.0005 in.	.002 in.	nil	nil
Minimum	nil	.001 in.	nil	nil
Average	.0005 in.	.0005 in.	nil	nil

Bottom Cylinders	No. 1	No. 2	No. 3	No. 4
Maximum	.002 in.	nil	nil	nil
Minimum	.0005 in.	nil	nil	nil
Average	.001 in.	nli	nil	nil

Wear on Main Bearings

	No. 1	No. 2	No. 3
Maximum	.002 in.	.002 in.	.002 in.
Minimum	.000 in.	.003 in.	.001 in.
Average	.001 in.	.003 in.	.002 in.

	No. 4	No. 5	No. 6
Maximum	.001 in.	.003 in.	.004 in.
Minimum	.001 in.	.002 in.	.003 in.
Average	.001 in.	.003 in.	.004 in.

Bearing shells were measured for thickness at four points. Average wear represents the mean of four measurements after the engine had operated 52 days under full load.

Lubricating Oil Used During 30-Day Test of First Worthington Engine

Engine Part	Brand of Oil	Drops Per Min.	Gal. Per 24 Hr.
Cylinders	Navy Mineral	16.7 per cylinder	3.19 gal.
Scavenge pumps	D.T.E. Extra Heavy	3.. both cylinders	0.25 gal.
Compressors	D.T.E. Heavy X	7.. all stages	0.57 gal.
Piston rods	Rubilene-Navy-600 W.	7 per rod	3.92 gal.
Hand feed	D.T.E Heavy med	—	0.28 gal.
Forced feed	D.T.E Heavy med	—	8.79 gal.

Total consumption for all purposes per 24 hr. was 17 gal. from which must be subtracted 2 gal. for leaks round main engine bedplate which gives an actual lubricating oil consumption of 15 gal. per day.

Time of Use for Each Brand of Oil on Piston Rods

No. of Days	Rod No. 1	Rod No. 2	Rod No. 3	Rod No. 4
8 (first)	Rubilene	Rubilene	Rubilene	Rubilene
14	Navy Min.	Navy Min.	—	—
22	—	—	Navy Min.	Navy Min
8	600 W.	600 W.	—	—

Editorial Notes Relative to Stops Made During the 30-Day Test and Other Points

Engine Stops

First stop for 2 hr. 33 min. to secure loose nut connecting No. 2 piston rod to its crosshead was due to the nut not having been sledged up tight during erection. A stop of this kind might occur when a ship is first placed in commission, but not on later voyages.

Second stop for 2 hr. 4 min. to renew leaky 1st stage suction valve on air compressor was caused by a broken strip in a feather valve and in a ship would have been reduced to a 10 min. stop. Nearly 2 hours were lost through lack of starting air pressure and the consequent need for replenishing the supply. In a ship the full pressure would be always maintained.

Third stop for 7 min. due to the same cause as the second stop indicates the time actually needed for shutting down the engine to make a replacement of the kind specified.

From the aspect of ship service these three stops simmer down therefore to a couple of stops to replace a broken feather valve strip in the compressor. Obviously ship engineers would soon have all the big nuts sledged up and there would always be an ample supply of starting air from the ship's big maneuvering air tanks.

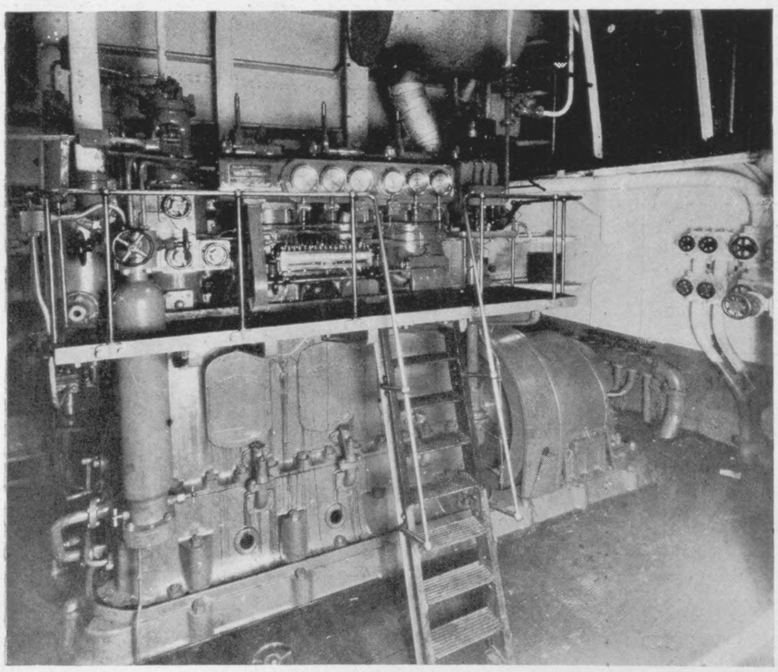
Measurements of Wear

Attention is drawn to the statement that these figures represent the wear after the engine had operated a total of 52 days and do not represent the wear merely during the 30 days' full load trial.

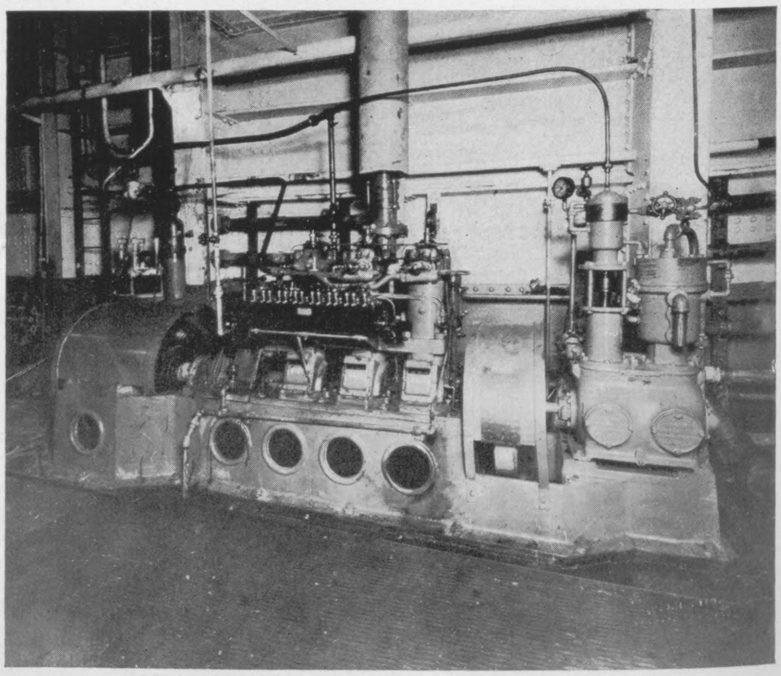
The "growth" figures represent actual measurable growth in the cast iron liners after the test. This phenomenon is similar to that experienced in prime movers using superheated steam.

Fuel Consumption

During the 24 hr. full power trial of the second engine the fuel consumption registered considerably below the figure recorded by the first engine during the 30 days' full power trial. The second engine showed 0.446 lb. per b.hp. hr. at full power compared with 0.473 lb. per b.hp. hr. in the first engine.



One of three 75 kw. Diesel generating sets



The 14 kw. port lighting and pilot compressor set

Economics of Ms. Tampa's New Machinery

(*Continued from page* 913)

operation without disturbance of its setting. The pump is conveniently located on the maneuvering platform and maintenance is simplified by the use of lapped-in sleeves in which ground plungers work without packing. Separate plugs are arranged over each valve in the pump.

TAMPA is a converted steamer originally fitted with a 24½ in., 41½ in., 72 in. x 48 in. triple expansion engine taking steam from water tube boilers. This machinery was designed to develop 2500 i.hp. at 78 r.p.m. The present machinery develops 2900 b.hp. at 95 r.p.m. The new machinery in the old machinery space is 30 per cent more powerful than the one it has replaced and it would have been easily possible to accommodate a 6-cylinder engine of the same model in this space. This would just about have doubled the original power. The compactness of the double acting 2-cycle engine could be illustrated in no better way. The present conversion was obviously not able to take advantage of this condition, but in new construction it will be possible to save quite considerably in machinery space with a corresponding increase of cargo and earning capacity. It is true that the rules for determining the net register tonnage penalize motorships because, with the present existing allowances, the smaller the machinery space, the larger the net tonnage—upon which dues are based—but if the increase of cargo space is big enough and if the nature of the cargo for which the ship is built permits its utilization it is evident that there must be a point at which it will pay to accept this penalty.

The saving in main engine weight compared with a single-acting engine is some 200 tons to which has to be added the saving in foundation weight due to the greater compactness and lighter weight of the double-acting engine. It is probably this same condition which was responsible for the lower installation cost in case of this ship compared with that for ships with single-acting engines. This amounted to some $32,000 per ship.

Machinery Weights of Ms. Tampa

Main engine, including accessories, silencer and spares	781,000 lb.
Shafting, bearings and propeller, including spares	144,000 lb.
Starting air tanks	63,000 lb.
Pumps	18,700 lb.
E. R. piping—water, air fuel oil, lub. oil and exhaust	75,900 lb.
E. R. floor plates, ladders and gratings	41,300 lb.
E. R. tanks	21,900 lb.
Generators and compressors and silencers	169,300 lb.
Heating boiler and stacks	22,800 lb.
Other engine room auxiliaries and fittings	24,100 lb.
Electric wiring, switchboards and fixtures	30,400 lb.
Steering gear, windlass and winches	99,000 lb.
Lux-Rich system	11,700 lb.
Other hull engineering items	57,100 lb.
Total	1,560,200 lb. = 700 long tons.

TAMPA is furnished with auxiliary compressors standardized for all ships coming under the Conversion Program and these have a total capacity of 510 cu. ft. of free air per min.—enough to keep the main engine going under full power. Such a large compressor capacity is not, however, required by the American Bureau of Shipping in case of double-acting 2-cycle engines which are able to run single-acting in an emergency. It is sufficient to have capacity for this single-acting engine. Applied to TAMPA this peculiarity of the double-acting 2-cycle engine would make it possible to reduce not only the compressor capacity but also the auxiliary engine power to that required by the deck machinery and would cut out one of the three auxiliary engines effecting a saving of some $20,000 in the first cost of the ship.

During the last year a number of fast passenger ships of large tonnage have been placed in successful service. Most of these ships have double-acting 4-cycle engines in twin screw arrangements, each engine has many cylinders and works at high rotative speed. These ships can therefore boast a much larger power than the unit installed in TAMPA with its four cylinders, slow speed and single propeller. If, however, we compare the engines on the basis of equal piston speed and cylinder for cylinder we find that TAMPA'S engine is more than the equal in power of these engines and yet we have not by far exhausted the possibilities of this engine type in horsepower capacity per cylinder. The double-acting 2-cycle engine has expanded the possibilities in power output per cylinder so radically that the modern Diesel engine industry at last is able to cover any demand which is likely to be made by the merchant marine. As one of the many who have toiled to help the Shipping Board Conversion Program along the writer wishes to acknowledge the splendid work done by the technical staff of the Shipping Board and the wholehearted cooperation extended to all of us to make our task more easy.

Elevated Winches and Housed Controls

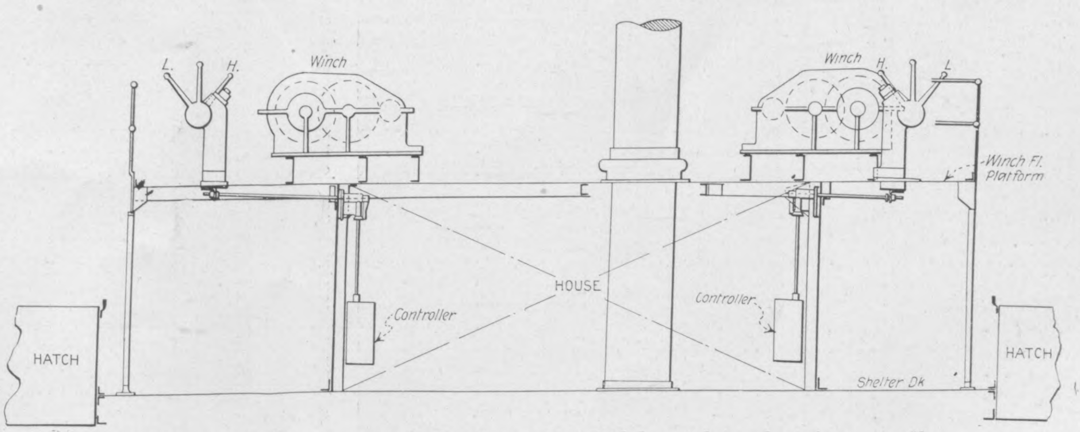
All Electrical Controlling Equipment for Tampa's Deck Machinery Is Protected from the Weather and Efficiently Ventilated

A SIMPLE conversion of a steam steering gear has provided TAMPA with a steering arrangement that has tested out very satisfactorily and gives promise of excellent service. The steam steering engine has been discarded, and the power is now applied by an electric motor driving through a flexible coupling and a worm gear to a new intermediate shaft. Yoke, connecting rods, nuts, guides, parallel rods, screw and pedestals have been used again and some of the other parts have been retained.

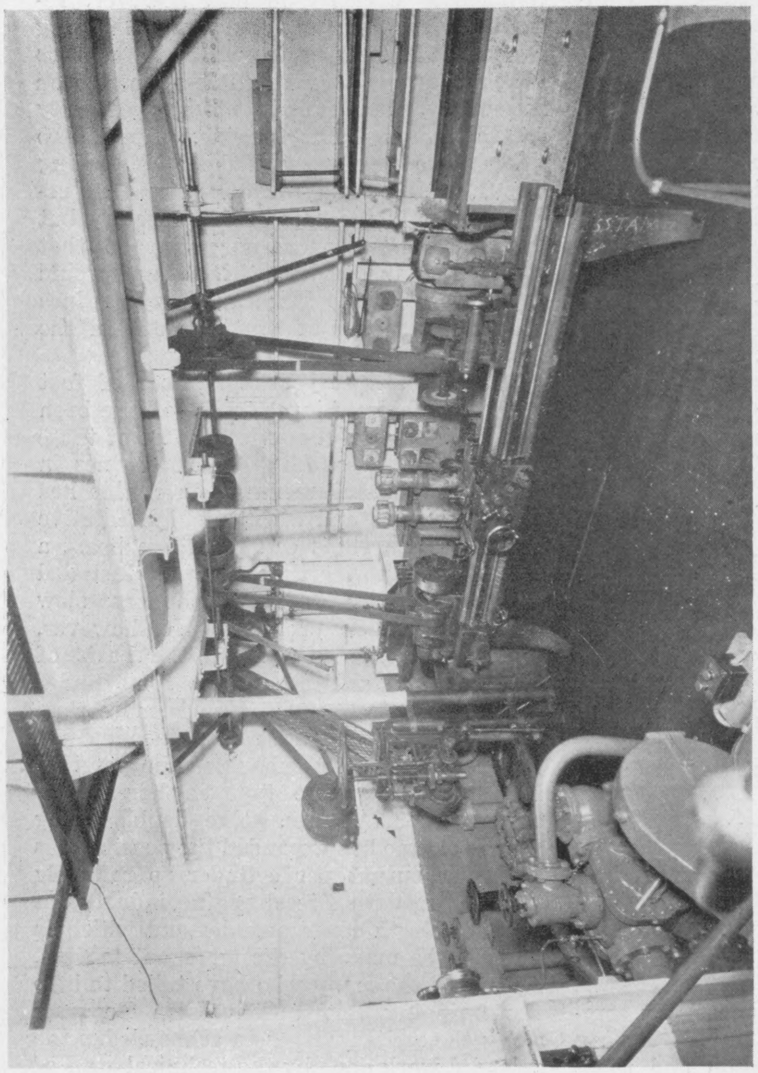
How the electrified screw gear appears is shown in one of the illustrations herewith. Rudder movements are accomplished by the turning of the electric motor in response to the contactors of the Westinghouse control panel. The actual steering, however, is performed by a Sperry 2-unit gyro-pilot on the bridge, which governs the rudder movements by directing the Westinghouse controls.

For a very precise and detailed description of the 2-unit gyro-pilot reference should be made to the March issue of MOTORSHIP. Here the function of that type of gyro-pilot can be summarized as an assembly of three independent methods of steering: (1) automatic electric steering under gyro control; (2) wheel steering with the usual ratio of 3½ turns from midships to hard-over and with electric transmission of the wheel movement to the rudder motor; (3) so-called "controller" steering, which is a non-follow-up system of electric steering, in which a plain handle is moved to one side or the other to obtain a corresponding rudder movement and the rudder brought back by throwing the handle in the reverse direction.

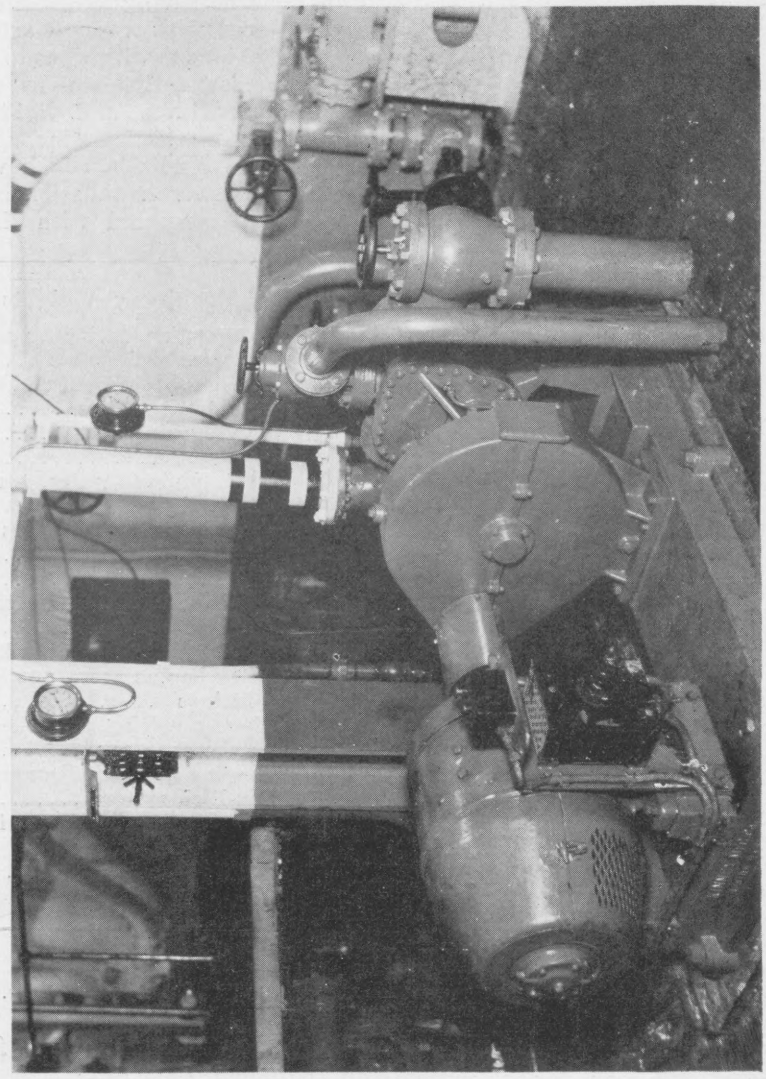
Both the gyro steering and the wheel steering require the use of a follow-ups connected with the rudder motor, this follow-up governing the contactors on the Westinghouse control panel. That is where the Sperry system links up with the West-



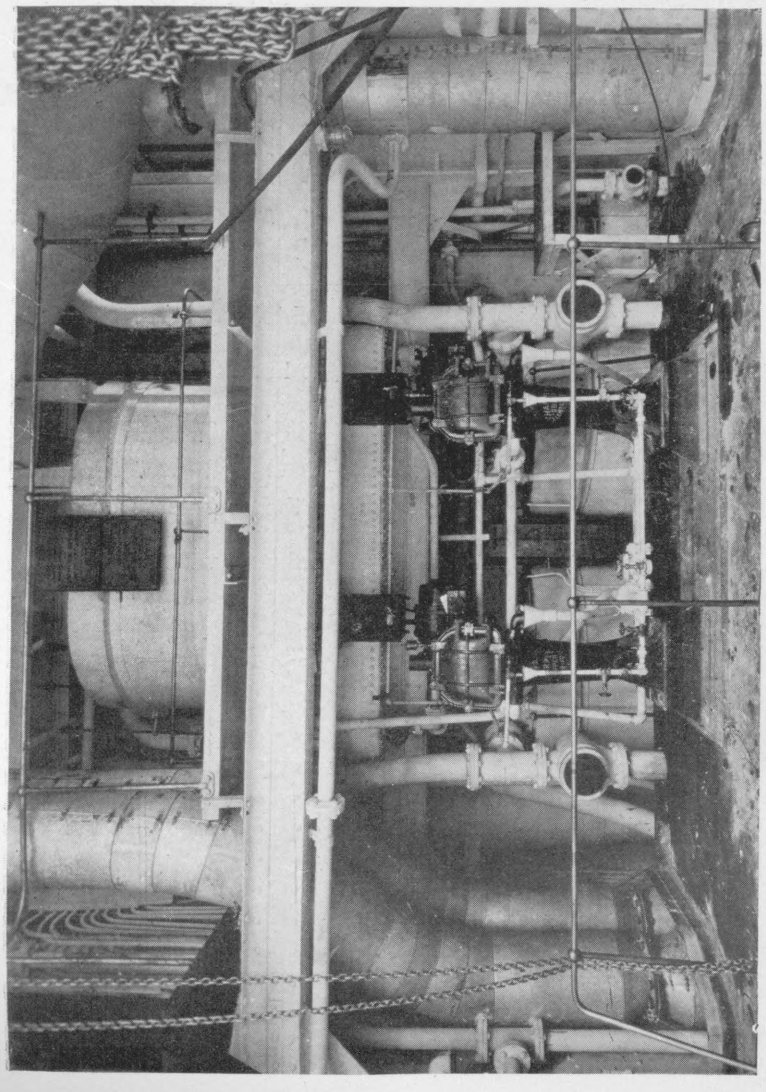
Master controllers are on house top connected by rod to electric controllers



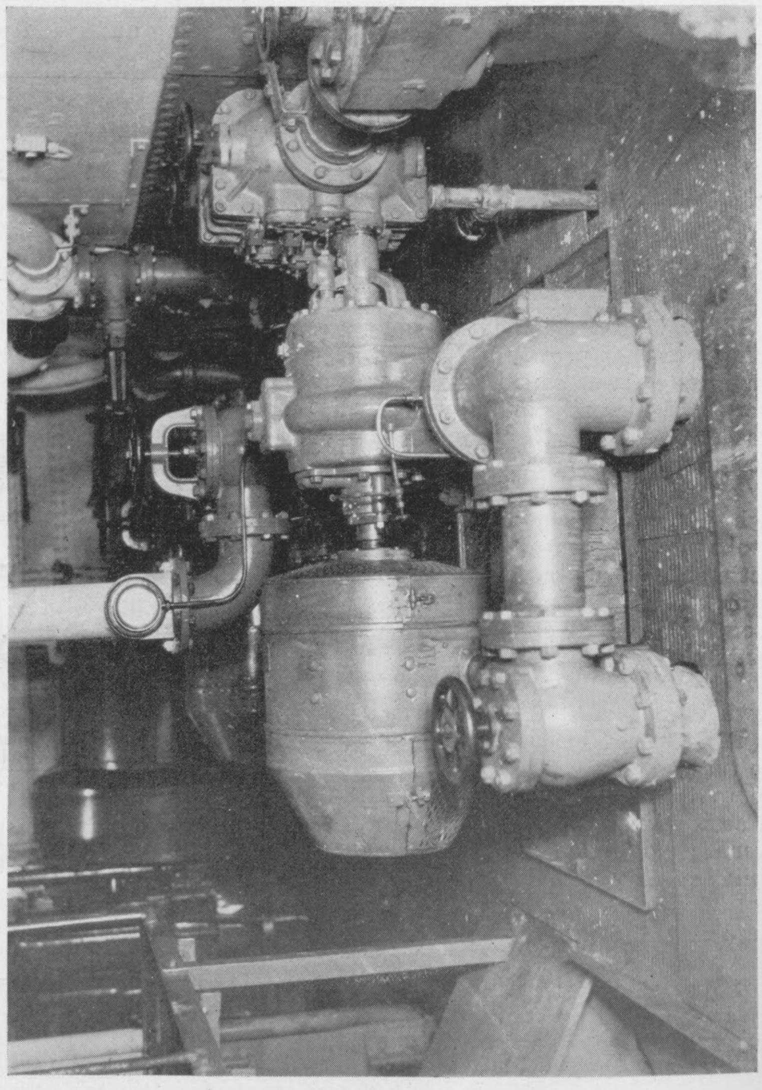
A corner of the well equipped engineers' workshop fitted at engine room floor level



Push button control of motors is one of the features of the pumping equipment



Battery of centrifuges is used for cleaning Tampa's fuel oil before it enters the engine



General service pump is a self-priming centrifugal unit of 750 g.p.m. capacity

inghouse power control. In the event that the bridge and wheelhouse be smashed the electric steering can still be used at a steering station on the poop house, but it is entirely separate then from the Sperry system and is controlled by a plain handle without follow-up, giving rudder movement as long as held over to one side or other. That style of steering, identical with the "controller" steering of the Sperry 2-unit gyro-pilot, requires a rudder angle indicator to show the helmsman how far the rudder is over.

If all the electric steering is out of business the steering gear can be operated by hand on the top of the poop house, and if the screw gear or be broken the rudder can be worked relieving tackle on the tiller or in a last resort by chains from the aft edge of the rudder plate led up through fairleads on both sides of the poop and connected with tackle run over the heads of the warping winch. That of course, is entirely an emergency steering arrangement.

The warping winch which is on the poop deck consists of an electric winch similar in all respects to the cargo winches, with the addition merely of an extra gear reduction to an extension shaft provided with warping heads just outboard of the poop house on both sides.

All the electric control equipment of TAMPA'S deck machinery is completely housed and therefore protected to the fullest extent against sea and weather. For the steering gear just described above this was no problem at all, the control equipment being housed in the steering engine room.

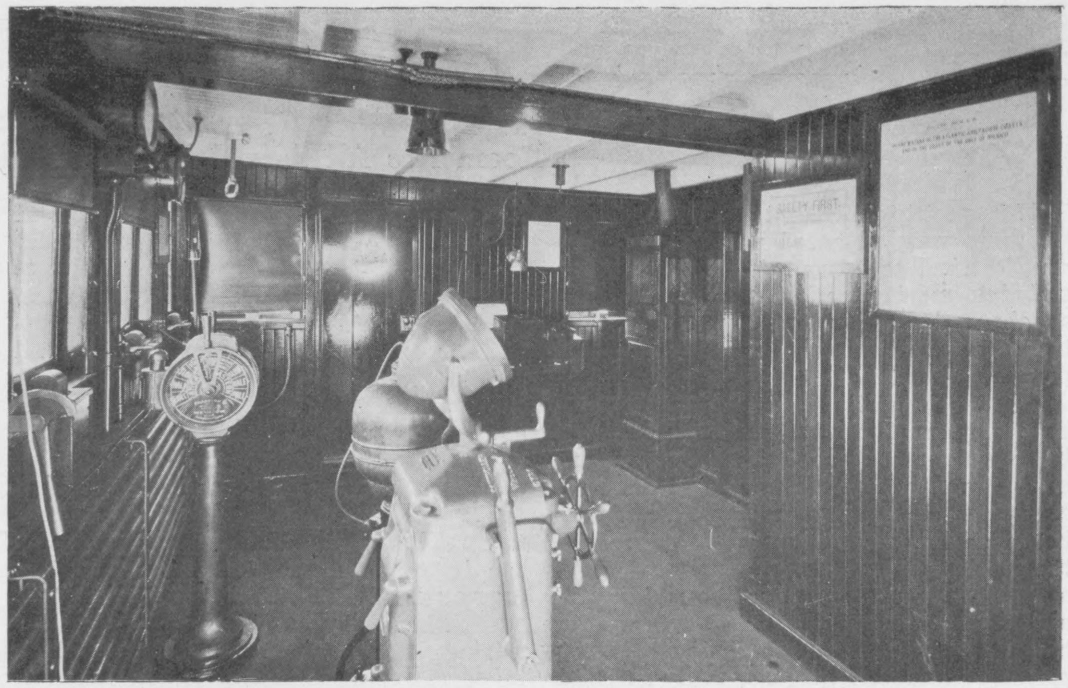
In the case of the windlass and winches separate enclosed spaces have had to be provided for the controllers, panels and resistances. These spaces are compartments in the super-structure for some units, whereas they have had to be specially built for the winches serving the forward holds and after holds.

The arrangement is a development of the SEEKONK winch installation. On TAMPA the winch handle on the winch platform is connected with a link system which enters the controller space through a stuffing box. Its arrangement can be followed very clearly in the drawing on the previous page. The winch operator asks only for a handle to control his winch, and if it works freely without sticking and gives him a sufficient choice of speeds he is satisfied. Where the controller is he does not even consider.

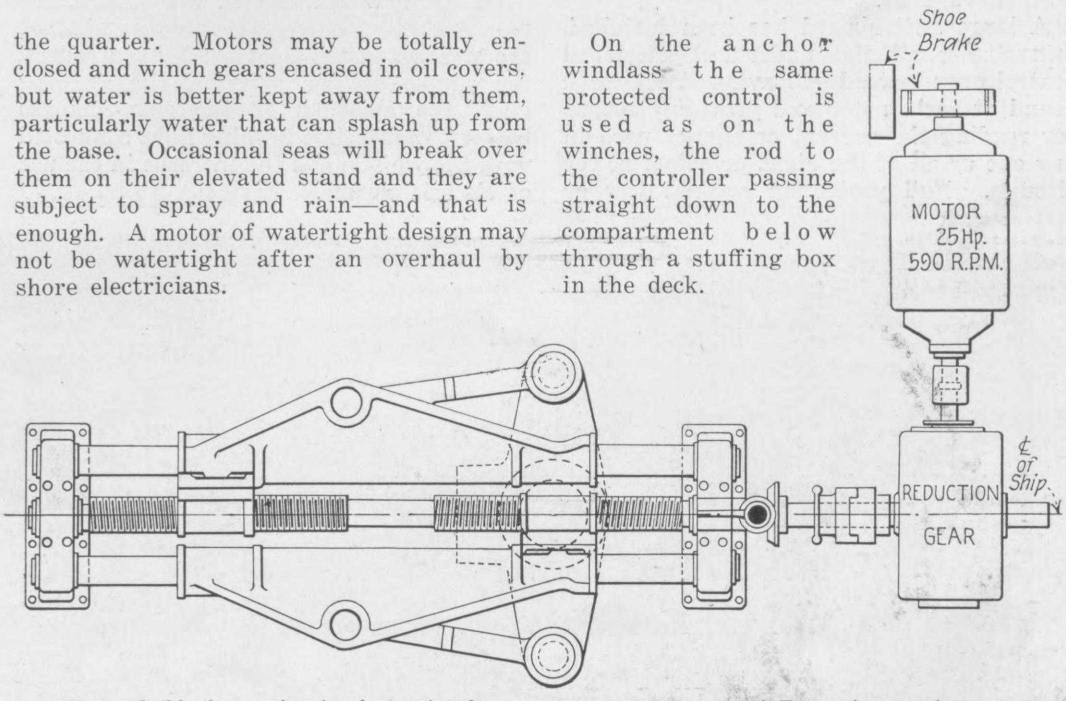
Locating the controller, panel and resistances in space that protects them from the weather permits them to be properly ventilated during use and keeps them in good operating order, ready always for hard service in port and without repair bills. If they are on the other hand kept outside, no matter how well they may be encased their condition is jeopardized by the human factor, the best of watertight boxes not being always firmly closed.

On TAMPA the raised platforms for winches have also been adopted. They keep the winches and winch operators clear of hatch beams, hatch covers and miscellaneous litter piled on the deck in port and raise the winches above the water that slops back and forth over the deck when seas break over the quarter. Motors may be totally enclosed and winch gears encased in oil covers, but water is better kept away from them, particularly water that can splash up from the base. Occasional seas will break over them on their elevated stand and they are subject to spray and rain—and that is enough. A motor of watertight design may not be watertight after an overhaul by shore electricians.

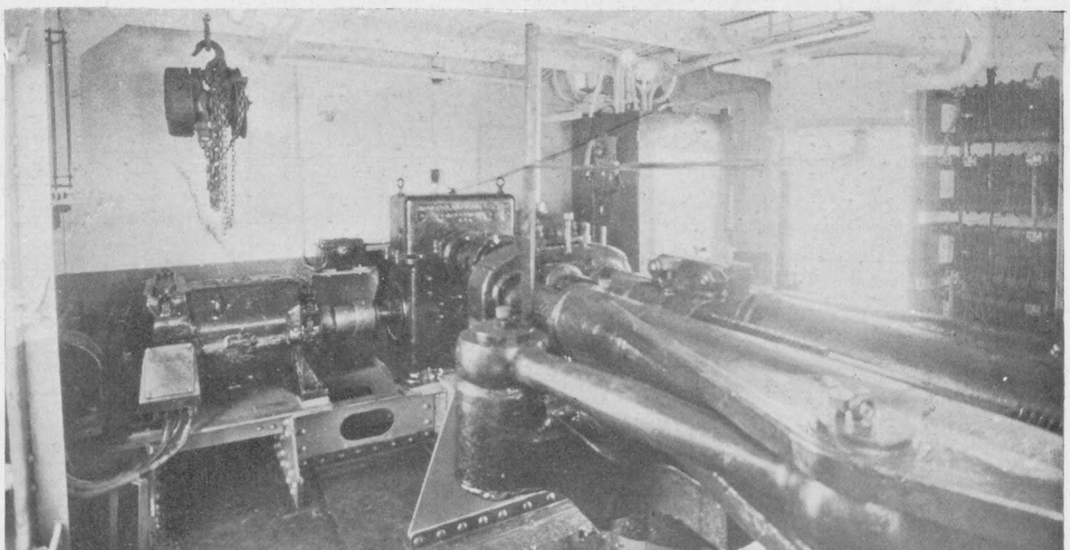
On the anchor windlass the same protected control is used as on the winches, the rod to the controller passing straight down to the compartment below through a stuffing box in the deck.



Modern electro-navigational practice is reflected in Tampa's wheelhouse layout



Remarkable ingenuity is shown in the present arrangement of Tampa's steering gear



Electric power is connected with the old screw type steering gear through gearing

Extensive Use of Electricity on Tampa

Bridge and Living Quarters as Well as Deck and Engine Room Are All Served by Electricity

IN respect to electrification, TAMPA represents very advanced practice. All her electrical equipment is of a character suited to marine work, below deck as well as above deck, and is operated and controlled in accordance with modern electrical practice ashore.

All the generators and the switchboard have drip-proof covers. The motor units in the engine room are started and stopped by push buttons on the motor with remote control on the switchboard, and these push-buttons have drip-proof covers. On deck the motors—all of the waterproof type—are exposed, but the controllers and resistances are housed in proper working spaces because they need ventilation and cannot perform satisfactorily if compactly enclosed in watertight boxes. Armored cables are used throughout.

A large switchboard has been installed, centralizing all the under-deck electrical control gear instead of leaving it scattered round at each motor and providing means for reading the current or energy used in any one or all of the eight principal power circuits. Full protection against wet or dampness is secured for all this equipment by the location of the switchboard under proper cover, its inspection and maintenance are adequately provided for, attention can be given quickly to circuit breakers, cut-outs or fuses, and the entire power and lighting system can be supervised—as it always should be—by one man at a single station.

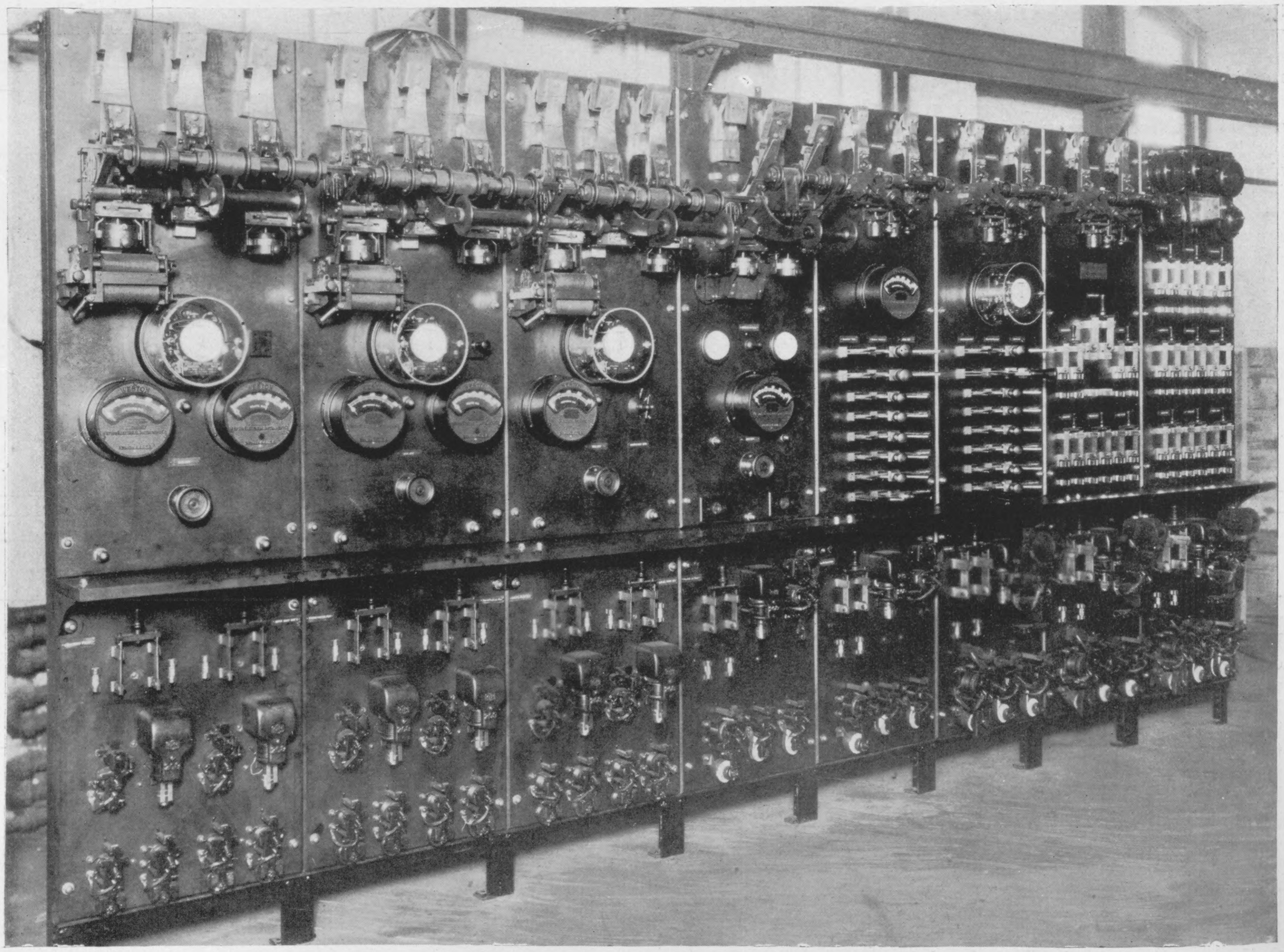
Practically all of the electrical features of TAMPA have been tried out in other ships during the last few years, but she embodies more electrical features in one vessel than can be found in any other freight ship. SEEKONK, J. W. VAN DYKE and EAST INDIAN have all contributed progress to the marine electrical art and assisted in the development represented by TAMPA'S electrical installation.

Of the new features in the TAMPA, the more noteworthy are the arrangement of the winch and windlass master controllers, the simple electric drive of the steering gear, the abolition of the gyro-compass battery, the electric flashing light connected with the whistle and the increase in the use of electric alarms.

A comprehensive understanding of the extent to which electricity is used aboard TAMPA and of the manner in which the controls are arranged, can most easily and clearly be obtained from the simple tabulation on the opposite page of the switchboard fittings as they appear in place. This can be understood without any more electrical knowledge than the average citizen possesses. It takes the mystery out of the switchboard. Compare the tabulation with the picture of the switchboard and observe that a simple name appears in the tabulation in place of each fitting in the picture.

There are four generator panels on the left upper half of the board, each protected by a circuit-breaker opening at 30 per cent overload. At the top of the next three panels are the overload circuit breakers for the three deck circuits that take considerable power, viz., deck auxiliaries forward, deck auxiliaries aft and the steering gear respectively. At the top of the right hand upper panel are the alarm gongs calling attention to failing lubricating oil, cooling water or daily supply fuel tanks.

Switches underneath the alarm gongs are



Tampa's main switchboard has eight panels, the component parts and functions of which are set out in tabular form on the opposite page

for the lighting circuits respectively to quarters amidships, quarters aft, engine room, cargo forward, cargo aft, galley, searchlight and running lights. On the adjoining panel are the switches for the low power circuits, such as the refrigeration, gyro compass, radio, centrifuges and engine turning gear. All these switches are of the "fused type," i.e., with a fuse inserted directly on each pole of the switch.

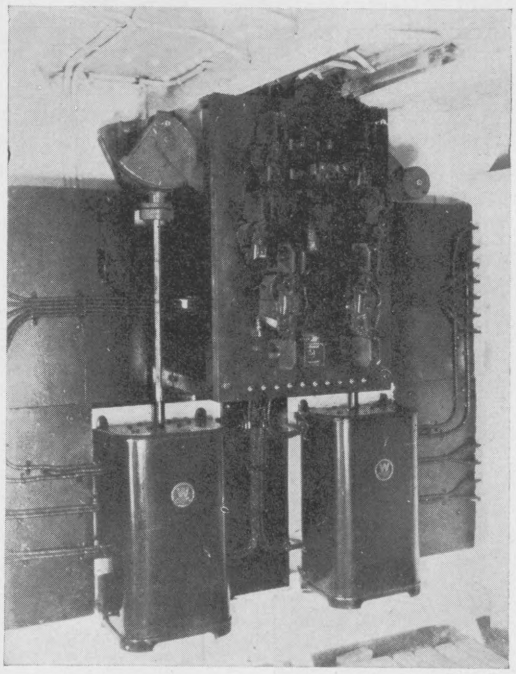
The other two rows of switches on the inner panels of the right upper half of the board are for testing and recording purposes, one set being for ascertaining the current in any one or more of the eight power circuits detailed in the tabulated diagram and the other set for obtaining a record of the total energy passed through any one or more of the same circuits.

A ground detector switch with two ground detector lamps for testing the whole electric system and for helping to locate "grounds," if any develop, are incorporated in the panel of Generator No. 4, the least used generator, this being the small port lighting generator. At the bottom of the same panel are plug sockets for the attachment of portable lamps.

The only other item to be mentioned on the upper part of the board is the switch for the emergency engine room lights. It is located on the panel of Generator No. 3 and serves to permit the emergency engine room lights to be connected to any generator ahead of the circuit breakers.

All the lower panels are given over to the various motor circuits in the engine room, 11 in all, detailed in the tabulated diagram. For the 7½ hp. motors the equipment is small enough to permit two motor circuits to be installed on each panel, but the 20 hp. motor and 30 hp. motors need bigger equipment which occupies one panel for each motor circuit.

These starting panels are all of the automatic type, operated by remote control push buttons, on the various motors themselves. The automatic control for each circuit consists of the line contactor—which opens and closes the circuit as the remote control push button is operated—with the additional devices to provide (1) smooth acceleration at starting, (2) low voltage protection and (3) overload protection. Actually the low voltage protection is incorporated in one of the accelerating contactors.



Pair of winch controllers

To obtain speed control of the electric motors there is a field control rheostat (properly protected against wet and moisture) at each of the 7½ hp. and 20 hp. motors. The 30 hp. motors operate always at constant speed.

That is all there is to the front of the switchboard, and its understanding does not tax the intelligence. The time has come when everybody having to do with the planning, operation or supervision of motorvessels must become acquainted with switchboards, because they centralize the auxiliary power of the ship. Do not examine the back of the board—that is the electrician's domain and can only be understood with specialized knowledge.

TAMPA carries an electrician who rates equal with the 2nd assistant engineer and who has charge of all the electrical equipment aboard, and there is a varied lot of it. In addition to the power units listed in the tabulated diagram of the switchboard there are the winches, windlass and steering engine, all with their controllers, on deck, the arrangement of which is outlined in an article in this issue dealing with the deck machinery. The electrician has the after winch house as an electrical storeroom and workshop.

On the bridge, electricity serves the gyro pilot, the flashing light connected with the whistle, the running light tell-tales, the searchlight, the Rich fire detector and the telephones. In the living quarters, which

(*Continued on page* 939)

Automatic circuit breaker GENERATOR 1	Automatic circuit breaker GENERATOR 2	Automatic circuit breaker GENERATOR 3	Automatic circuit breaker GENERATOR 4	Automatic circuit breaker DECK AUX. FOR'D.	Automatic circuit breaker DECK AUX. AFT.	Automatic circuit breaker STEERING ENGINE	Alarm signals Switches for
Watt-hour meter Ammeter Voltmeter Field Rheostat	Watt-hour meter Ammeter Voltmeter Field Rheostat	Watt-hour meter Ammeter Emergency Lights Field Rheostat	Ground Detector Lamp-Switch-Lamp Ammeter Field Rheostat Plug Socket Plug Socket	Ammeter and 8 Selector switches to test Steering motor Deck line forward Deck line aft F.O. transfer pump-1 F.O. transfer pump-2 S. W. cooling pump Gen. service pump F. W. cooling pump	Watt-hour meter and 8 Selector switches to test Steering motor Deck line forward Deck line aft F.O. transfer pump-1 F.O. transfer pump-2 S. W. cooling pump Gen. service pump F. W. cooling pump	Switches for Gyro compass Refrigerator Galley circuit Turning gear motor Fuel oil centrifuge Radio	Cargo for'd lights Quarters aft Lub. oil centrifuge Cargo aft lights Engine-room lights Searchlight Running lights Spare switch Quarters amidships
Line switch, Line contactor, Overload relay, 2 accelerating contactors — SANITARY PUMP Line switch, Line contactor, Overload relay, 2 accelerating contactors — MACHINE SHOP	Line switch, Line contactor, Overload relay, 2 accelerating contactors — F. W. PUMP Line switch, Line contactor, Overload relay, 2 accelerating contactors — E. R. BILGE PUMP	Line switch, Line contactor, Overload relay, 2 accelerating contactors — LUB. OIL PUMP-2 Line switch, Line contactor, Overload relay, 2 accelerating contactors — LUB. OIL PUMP-1	Line switch, Overload relay, Line contactor 3 accelerating contactors FIRE & BILGE PUMP	Line switch, Overload relay, Line contactor 3 accelerating contactors F. O. TRANSFER PUMP	Line switch, Overload relay, Line contactor 3 accelerating contactors F. W. COOLING PUMP	Line switch, Overload relay, Line contactor 3 accelerating contactors S. W. COOLING PUMP-2	Line switch, Overload relay, Line contactor 3 accelerating contactors S. W. COOLING PUMP-1

Switchboard by the Walker Switchboard Co., with I. T. E. circuit breakers, Weston ammeters and voltmeters, Sangamo watt-hour meters, Cutler Hammer controlling apparatus on all the motor panels and Trumbull knife switches. Canopy of Armco rust-proof iron.

The above diagrammatic representation of Tampa's switchboard makes clear the function of every detail on the front panels

The Men Behind the Diesel Conversions

Shipping Board Authority Was Voted to Admiral Benson and Fleet Corporation Responsibility Delegated to Capt. Gatewood

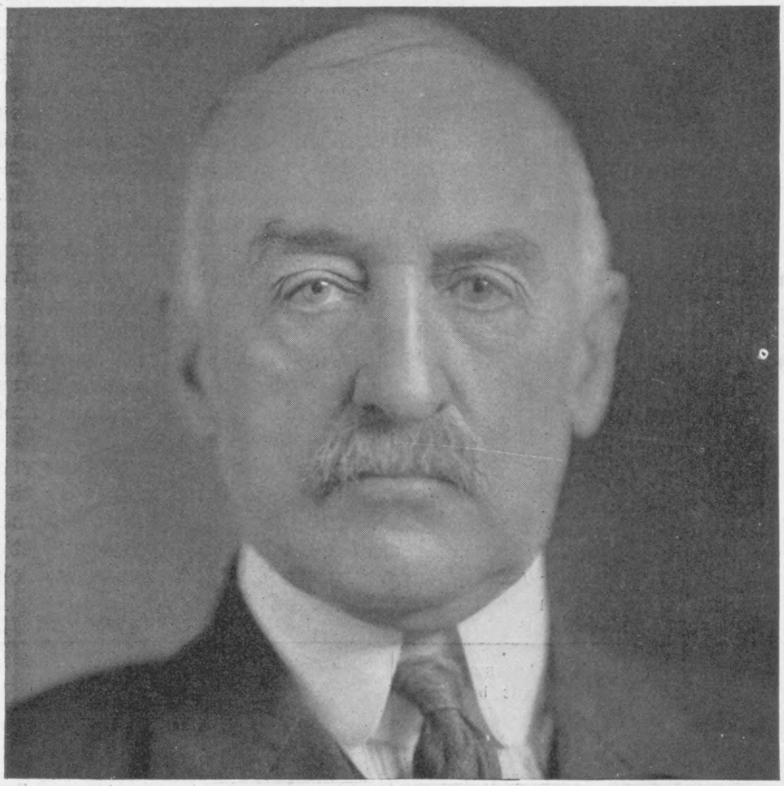
IT would have been entirely fitting to have changed the name of the first S.B. converted vessel and rechristened her ADMIRAL BENSON, for the Admiral has consistently and wholeheartedly worked for the recognition of the Diesel engine during the 6 years he has been a Commissioner of the Shipping Board and has witnessed the actions of the Board change from veiled opposition against this type of power to decisive support of it.

When Admiral Benson was appointed Commissioner in 1920 the Diesel engine needed an ardent and able pleader in official circles, where it was known principally not for its merits but for its political irritancy. Admiral Benson, who had retired a year previously from the Navy, had, in his capacity of Chief of Naval Operations and as naval member of various U. S. war committees been sent to Europe, and as naval advisor to the American Peace Commission had opportunities to learn how European opinion on motorships was crystalizing and he returned to this country a profound believer.

MOTORSHIP had been keeping the motorship issue to the front in Washington several years prior to Admiral Benson's appointment as a Shipping Board Commissioner, but when his official influence and support became available those constructive efforts soon produced results. MOTORSHIP had succeeded in having clauses written into the Jones Act that opened the way to motorship development, but the Conversion Act was needed to interpret part of the spirit of the Jones Act in a specific way and to authorize the Shipping Board to spend $25,000,000 of the fund that private shipowners were not using. Admiral Benson stood squarely behind that legislation and expressed the Board's official approval of it.

By resolution of the full membership of the Board its authority has been delegated to Admiral Benson in all matters relating to ship construction, maintenance and repair. By virtue of that authority he has supervised the Conversion Program on behalf of the Board and is entitled to very great credit for having directed it forcefully, sincerely, without favor to any and with only the thought in mind of his duty.

William Shepherd Benson was born in Macon, Ga., 71 years ago. After graduating from Annapolis he obtained his appointment to the rank of ensign in 1881. Most of his service was afloat, but he received various assignments to the Naval Academy and four years after obtaining his captaincy in 1909 was appointed commandant of the Philadelphia Navy Yard. In 1915 he was promoted to rear-admiral and selected as Chief of Naval Operations. In 1917 he was made the naval member of the committee appointed by the President to confer with the Allied Powers in Europe and in 1918 represented the U. S. Navy in the drafting of the naval terms of the armistice. After serving as naval advisor to the American Peace Commission, he returned to the U. S. in June, 1919, and continued as Chief of Naval Operations until he was retired 3 months later under the provisions of the law, having reached the age limit of 64 years. He was appointed Shipping Board Commisisoner for the Atlantic Coast in 1920, and qualified in 1922 for a 6 years' term.



Admiral W. S. Benson, U. S. N., Shipping Board Commissioner for the Atlantic Coast

Capt. R. D. Gatewood, C. C., U. S. N., Manager Maintenance and Repair Division, Fleet Corporation

The burden of watching the due performance of the contract work in connection with the Conversion Program devolved upon Captain R. D. Gatewood, Manager of the Maintenance and Repair Division of the Fleet Corporation. Captain Gatewood was very successful in assembling an excellent staff of loyal and experienced men who have stayed with the work unfalteringly, resisting all inducements offered them to transfer their services to better paid positions in private business.

Capt. Gatewood graduated from the U. S. Naval Academy in 1903 and spent about a year at sea prior to assignment to the Construction Corps of Navy. He attended the Massachusetts Institute of Technology, graduating from there in 1906 and was assigned then to the Mare Island Navy Yard on ship and outside supervision work. After six years there he was appointed Fleet Constructor of the Atlantic Fleet on the staff of the Commander-in-Chief. His next assignment was to the Philadelphia Navy Yard. There followed two years as Superintendent of the Mechanical Division of the Panama Canal, from which he returned to duty at the Philadelphia Navy Yard for about a year. Admiral Benson, when Chairman of the Shipping Board, called him to duty with the Emergency Fleet Corporation, as Director of Construction and Repairs, engaged on winding up the construction program. This position he still holds and since August 1, 1925, has in addition been given duty as District Director of the Fleet Corporation.

Tampa Converted $60 per D.W. Ton

Greatly Reduced Operating Expense and Increased Earning Capacity Will Enable Tampa to Operate at a Profit

WHAT has been accomplished in the conversion of TAMPA from a steamer to a motorship is the reduction of operating expenses by $40,000 to $60,000 a year—according to price of oil and number of days at sea—and improvements in cargo carrying capacity that will make for better earnings because she can carry a bigger as well as a more valuable cargo. Her superiority as a transportation unit in her present form is evidenced in the table hereunder.

Actual cost of converting her from a motorship into a steamer and adding a knot to her speed has been around $540,000 for machinery and for shipyard work, equal to about $60 per ton d.w.

Of the individual items composing the cost of conversion, the main engine was the most important, its price with spares having been $212,000, which is equivalent to about $73 per brake horsepower. A sum of about $80,000 was spent in the purchase of the generator sets, pumps, switchboard and other engine room items. The deck machinery, including the winches, all motors and controls, cost about $30,000. To install all this machinery cost about $210,000.

Tabulating the items chargeable against the conversion, the following summary shows the actual cost:

Cost of Tampa's Conversion

Main engine (including spares)	$212,000
Engine-room auxiliary sets, pumps, switchboard, controls and cable	80,701
Deck machinery, including controls, motors, cable and steering gear	29,321
New shafting and propeller hub	9,000
Installation cost, strictly incident to conversion	210,000
Total cost	$541,022

In preparing TAMPA for her new machinery everything pertaining to the steam equipment had to be torn out. Boilers and engine were removed, the condenser, steam pumps, dynamo, ice-machine and all piping and connections lifted away—in fact, engine room and boiler room were gutted, even the shafting being unsuitable for the increased power. Of the original deck machinery only the windlass drum and gear and the steering gear (both without their engines) could be used again; all the winches had to be stripped and the steam lines forward and aft ripped out. The two big fuel oil settling tanks in No. 3 hold were no longer required and also went to the yard.

Due to the concentration of weight in the Diesel engines a considerable stiffening had to be added in way of the machinery, the inner bottom structure was reinforced and strong foundations built on the tank top for the main and auxiliary engines. The yard sought permission to add greater stiffening than the specification called for, and finally a compromise was made between the yard's recommendations and the owner's specification.

With a higher shaft line in the new engine it proved necessary to raise the top of the shaft tunnel in order to provide sufficient headroom in the shaft alley. Between the thrust recess and a point about 3 ft. aft of the bulkhead at the aft end of cargo hold No. 5 the arch of the tunnel was cut off and raised, extension pieces inserted in the stiffeners and a shutter strake used on both sides to close the gap in the plating, the whole being riveted and all joints welded.

With the new shafting, new spring bearings were called for on the raised stools. The Shipping Board called for a modified Navy form of spring bearing, in which a scraper continually leads the oil off a carrier collar on the shaft, the collar lifting the oil from a bath in the base and the scraper delivering it to a flume in the bearing cap through which it is conducted to spread over the journal where the upper part of the bearing shell is cut away for that purpose. The effectiveness of this type of lubrication was shown after a 6 hours' full power trial, at the end of which period the bearings were cold.

Comparison of Tampa as Steamer and as Motorship

	STEAMER	MOTORSHIP
Gross register	5948 tons	5959 tons
Net register	3823 tons	3703 tons
Displacement (load)	13,010 tons	13,010 tons
Endurance	14,000 miles	14,000 miles
Total deadweight capacity	9550 tons	9120 tons
Fuel oil	1878 tons*	760 tons
Lubricating oil	......	16 tons†
Fresh water	330 tons	164 tons
CARGO DEADWEIGHT CAPACITY (full endurance)	7330 tons	8180 tons
CARGO DEADWEIGHT CAPACITY (half endurance)	8440 tons	8660 tons
Power—main engine	2200 s.hp.	2900 s.hp.
Service speed (about)	9.9 knots	11½ knots
Gain of time on full endurance	......	5½ days
Passenger accommodation	......	11 passengers

*Steamer has to use deep tanks as oil bunkers for endurance of 14,000 miles. (This endurance may be compared with New York-Buenos Aires-New York 11,742 miles or New York-Manila-New York 22,728 miles via Panama.) †Only 3.2 tons will be consumed for all purposes in 14,000 miles.

With the new tailshaft a McNab-Vista system of lubrication was fitted to the stern-tube, and so on throughout the vessel: wherever the structure was touched an improvement was introduced. The sum total of all the changes has been that a first-class job has been secured, the Shipping Board specifications having called for many improvements and the best materials, while the shipyard furnished good workmanship and deferred to the exacting requirements of the excellent inspectors who watched the work for the Shipping Board. A glance at the list of machinery equipment now installed in TAMPA suffices to show how extensive the conversion was, having been spread right through the ship. A cost of $60 per d.w. ton has wrought a great improvement in the mechanical equipment, considerably bettered the cargo deadweight capacity, greatly decreased the operating cost and added 10 per cent to the speed of the ship.

TAMPA would have required hull repairs had she ever been used again as a steamer. The $26,000 spent on her for this purpose at Newport News would have been greatly exceeded had her steam machinery been retained. This item is not chargeable against the cost of conversion.

Her equipment and outfit was run down and needed restoring: even a considerable length of new chain cable, for instance, had to be supplied. This entailed a further outlay of $25,000 which would have been chargeable against the vessel as a steamer and is not therefore any part of the cost of conversion.

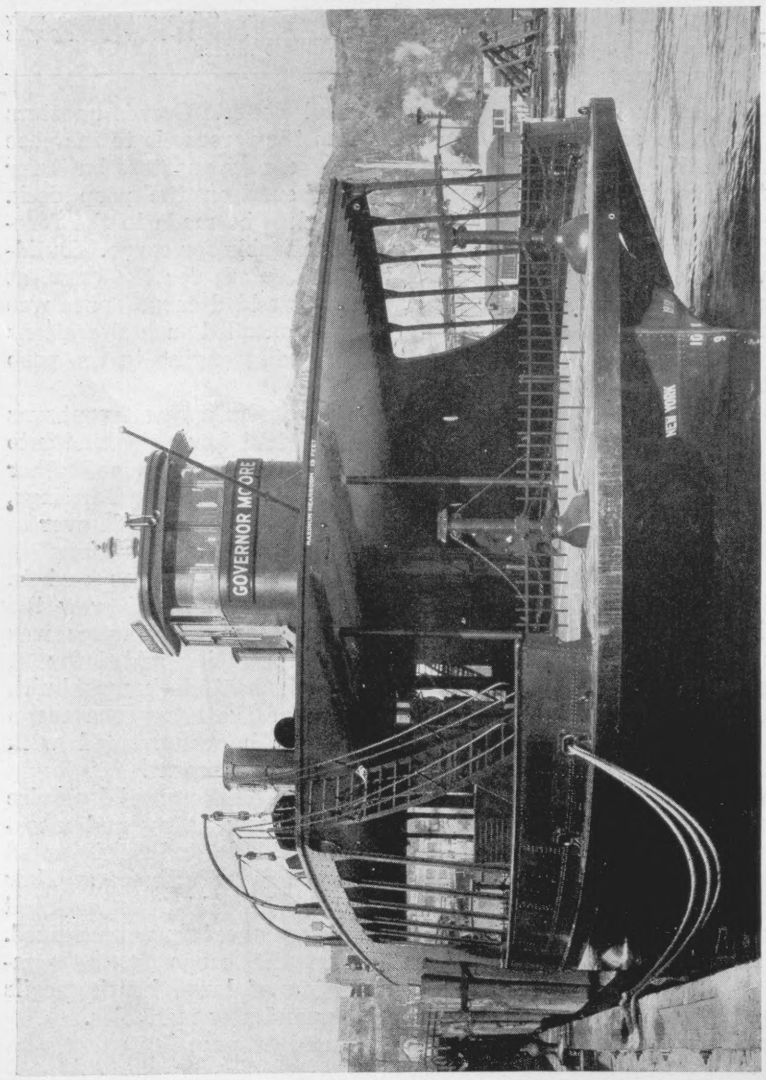
Advantage was taken of the visit of the vessel to the yard to put in hand very considerable betterments to suit her for special service on tropical routes. Crew's quarters were moved from the forecastle to increase the cargo space and airy quarters built for them in a new house on the poop deck. Many changes had to be made in the forecastle to make it suitable for cargo. Building the new quarters aft for the crew, at the same time that added cargo space was to be gained there, entailed such alterations as raising the steering engine to the poop deck, etc.

In the bridge quarters a new layout was made, the two original houses joined into one, entirely new cabins, toilets and other spaces built, with new trim and fittings, and the whole accommodation made over to provide comfortable living conditions in tropical seas, off tropical shores and in tropical ports. For officers and crew the highest modern standard of quarters was adopted, and accommodation added for 11 passengers. A new boat deck was built, and in the course of the changes a cargo hatch trunk had to be constructed with new king posts and equipment.

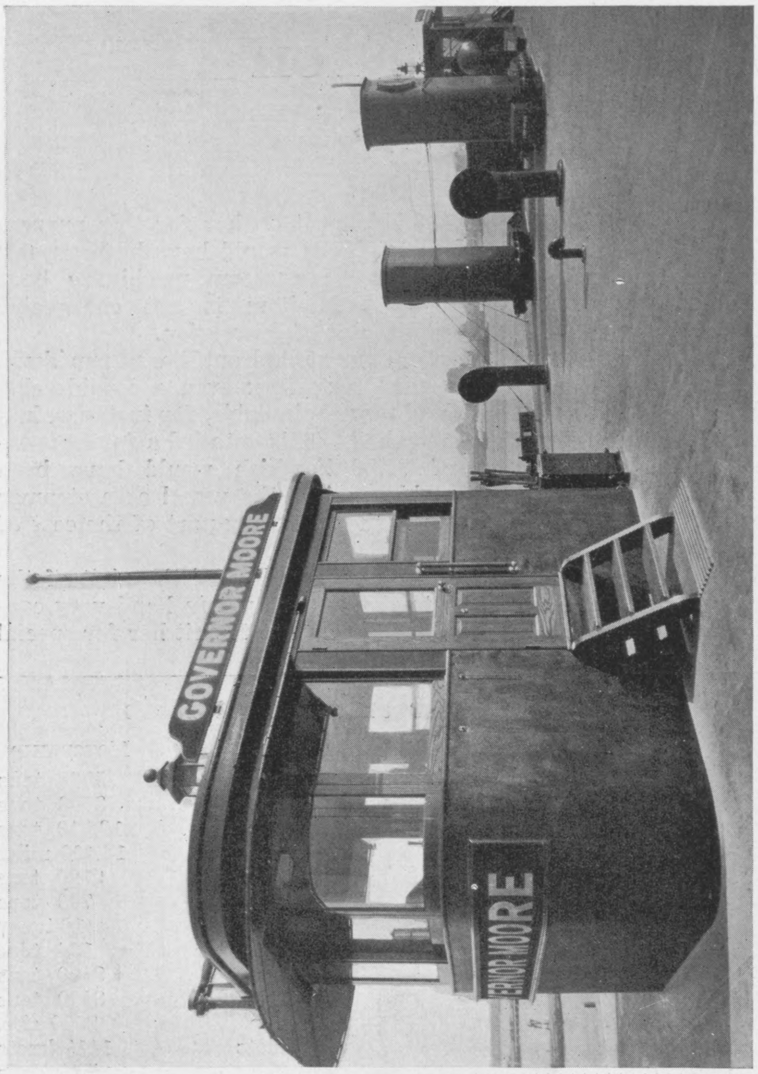
These alterations and the special service in view required a new galley and messrooms, improved and enlarged refrigerated space and the necessary adjuncts. New ventilators had to be added to enclosed spaces and all living quarters were vented.

Betterments in the cargo spaces comprised the addition of large heating coils in the deep tanks and new manholes.

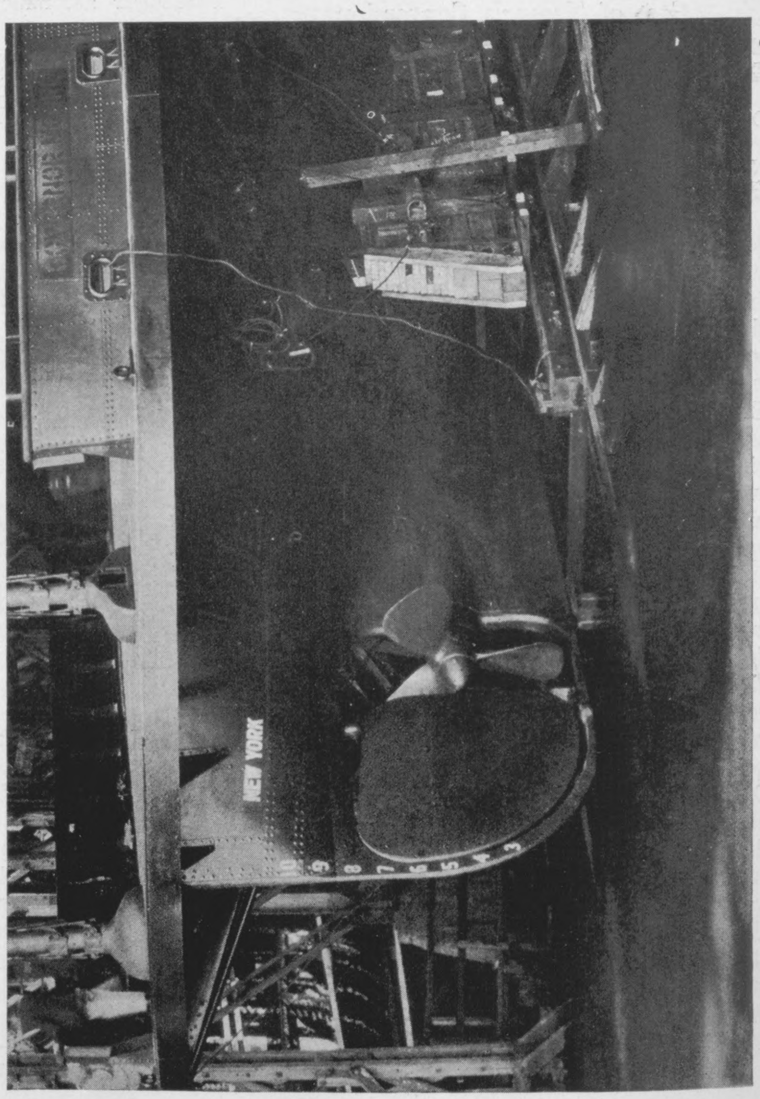
(*Continued on page* 928)



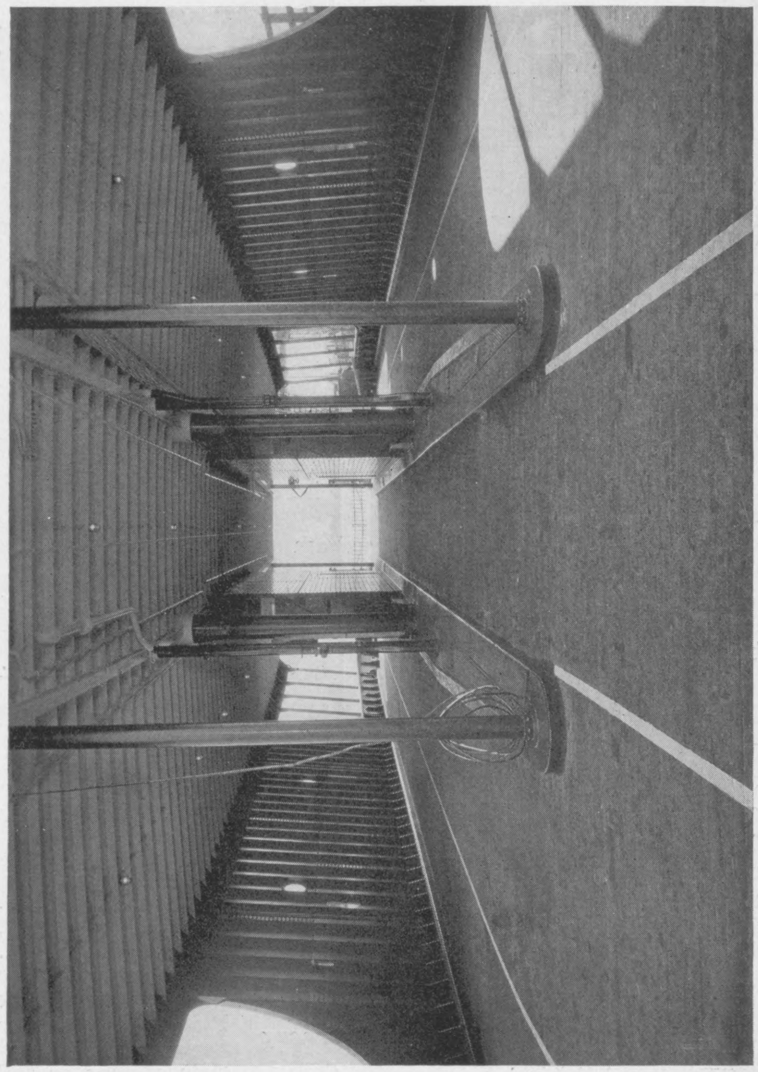
Diesel-electric ferryboat Governor Moore has a wide deck space for vehicular traffic



Superstructure deck has the two pilot houses and twin stacks with Diesel exhausts



Shows details of end construction with special type "stem" bar to protect rudder



Five wide, clear driveways are arranged on the spacious main deck

New York's First Diesel-Electric Ferries

Comprise Fleet of Six Fast Vessels, Handling Autos, Which Will Save $40,000 per Boat per Annum

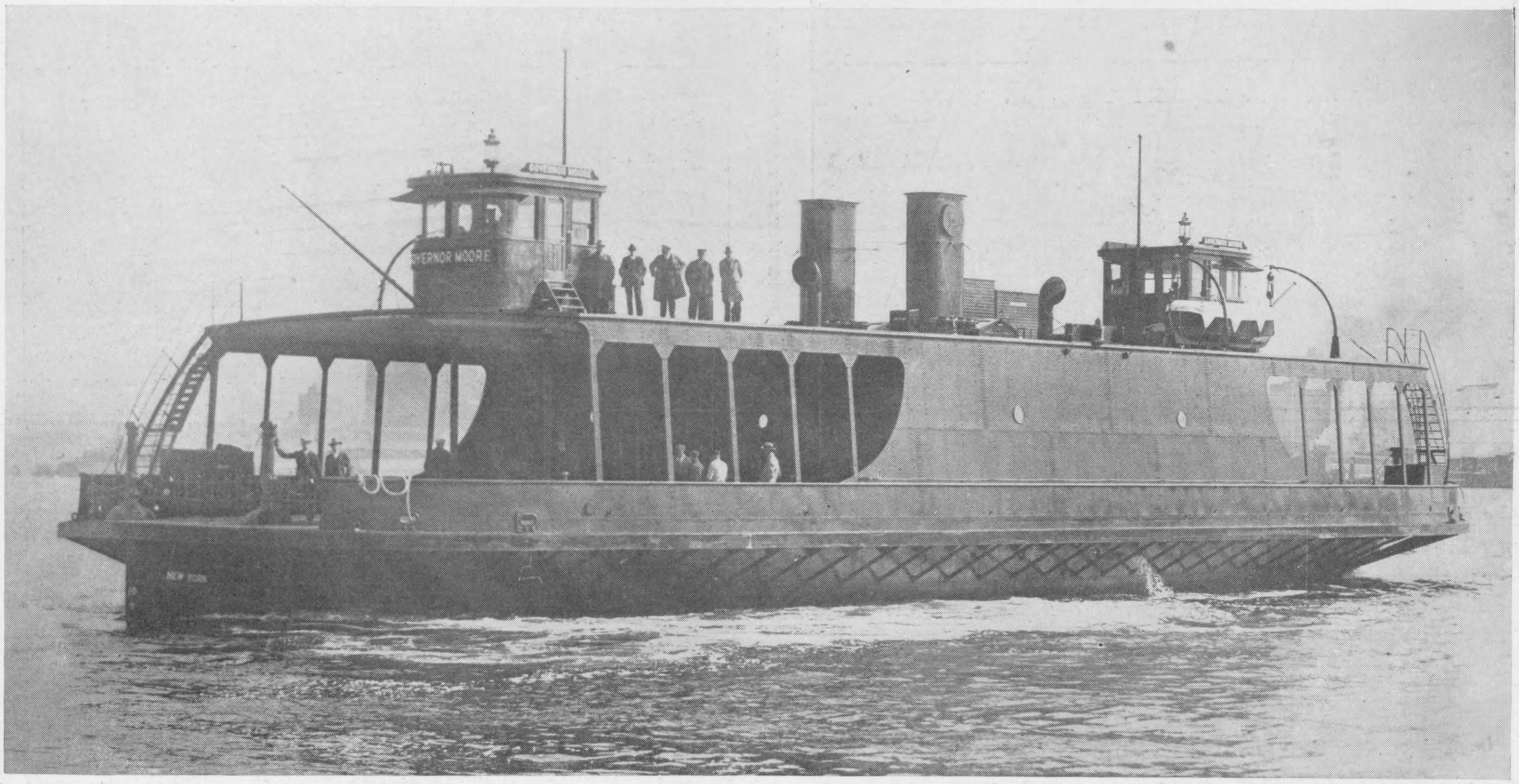
NEW YORK'S first Diesel-electric ferryboats* are now in service, and compared with steam-driven ferryboats of similar capacity are expected tc operate at a saving of over $40,000 per year per boat. Besides being the first vessels of this type to operate on the Hudson River they are also the first of their kind on the East Coast, and their arrival, although just 4 years behind that of the first Diesel-electric ferry on the West Coast, marks a distinct epoch in the development of the internal combustion engine for harbor work.

Characteristics of Electric Ferries

Length overall	155 ft. 0 in.
Length, b.p.	131 ft. 0 in.
Beam over guards	48 ft. 6 in.
Beam, molded	37 ft. 0 in.
Depth, molded	14 ft. 3 in.
Displacement, light (app.)	500 tons
Draft, light	8 ft. 6 in.
Draft, load	9 ft. 0 in.
Power	580 s.hp.
Control	Pilot house
Speed	13 m.p.h.
Auto capacity	46
Number of driveways	5

provide economy in operation plus increase in earning capacity.

In the new Diesel-electric ferries the hull proportions are different from those which rule for steam ferries. The draft is less and the beam is greater. On the deck there is a noticeable saving of space due to the abolition of the usual trunk for the boiler uptake and engineroom ventilation, its place being taken by two very narrow trunks on both sides of the center vehicle lane. These narrow trunks are reduced to the minimum that will comply with the



New York's first Diesel-electric ferry, a double-ended vessel of 580 s.hp., specially designed for automobile transportation across the Hudson

MS. GOVERNOR MOORE and ms. CHARLES W. CULKIN launched in October from the Camden plant of American Brown Boveri Corp. and placed in service early in November are the first two of six similar vessels constructing for Electric Ferries, Inc., New York. This company, which is one of two private concerns operating ferryboats in the New York district, all the other service being railroad or municipally owned, plans to operate all six vessels between 23rd Street, New York City, and the Erie Railroad terminal at Weehawken, N. J., and also between 23rd Street and the terminal of the Erie Railroad at Undercliff, N. J. The company has a lease from the Erie Railroad granting to it the use, with the railroad, of the Manhattan terminal, and exclusive use of the pier space at the terminals on the Jersey side, where the company has constructed new ferry slips, connecting roads, plaza space and viaduct giving direct access at easy grade, to the boulevards and traffic arteries adjacent to these terminals.

The running of these vessels—the first Diesel electric ferries on the Atlantic Coast—will be an innovation in New York harbor transportation, and with this new service old-time steam-driven ferries will have distinctly modern competition. The boats have been especially designed by Eads Johnson, Inc., of New York, and will be operated exclusively for motor vehicles. The keels for all six ships were laid early in June, and construction of the first two has been completed in the remarkably creditable time of 4 months. The remaining vessels will be delivered at close intervals within the next few weeks.

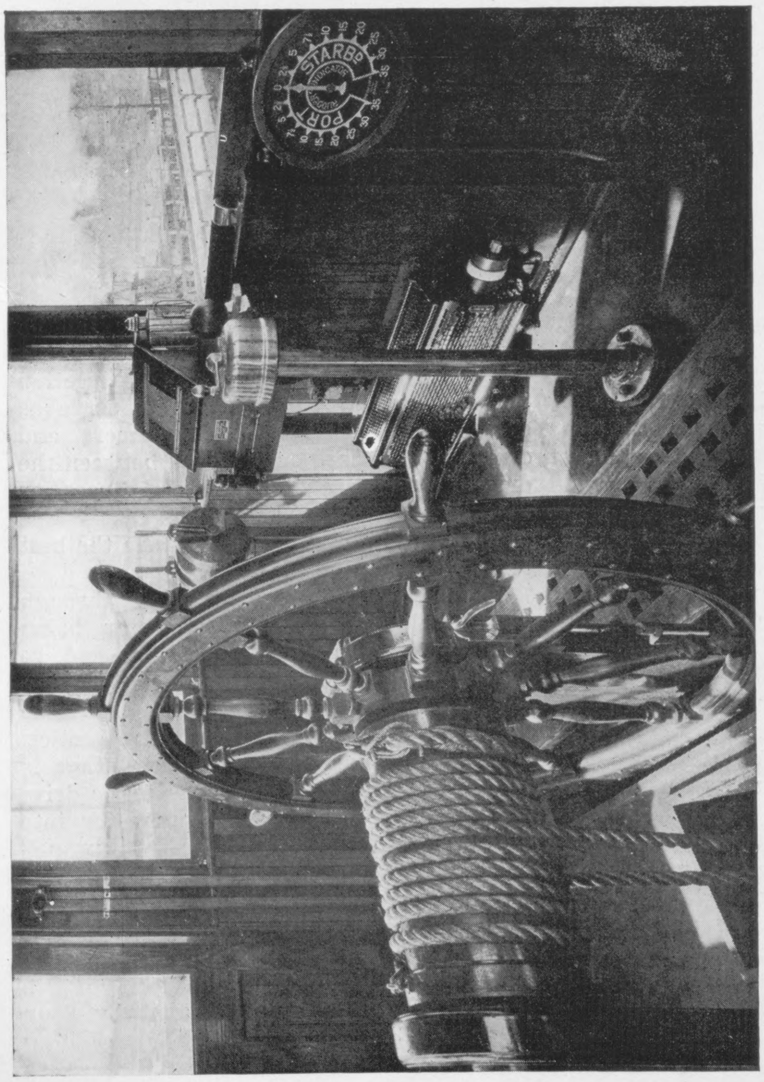
The hulls, of double ended type usual for harbor ferryboats, are constructed of steel and the general layout shows that economy is only one of the attractive features of the Diesel engine and that some of its greatest benefits are to be derived from the improvements in hull design and arrangements which it renders possible. A Diesel engine in a hull designed for steam will give economy, but a Diesel engine in a hull adapted to this modern style machinery will

regulations of the Steamboat Inspection Service, having sliding doors to serve as emergency exits for the engineers and companion hatches on the deck between the driveways, for ordinary use. Buses or heavy trucks are parked in the center lane of the five lanes on deck, to secure the best conditions of loading.

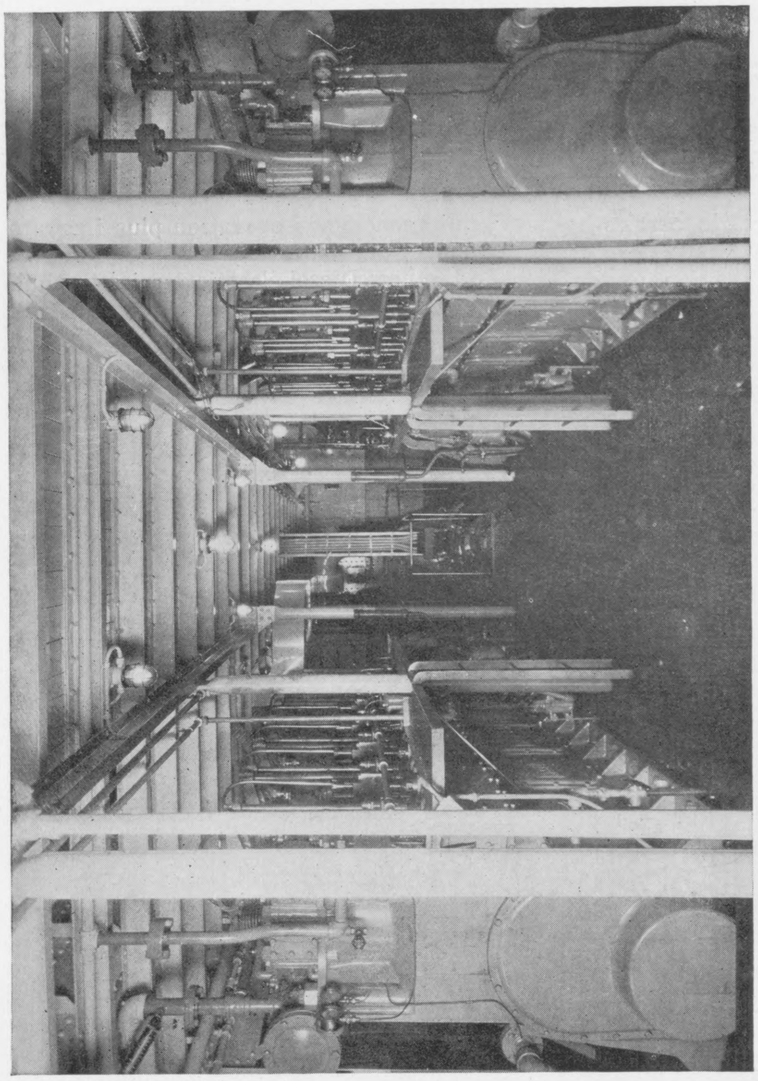
The electric drive is of straight through type, one double armature motor being connected to a propeller at either end, so that both propellers, which are opposite turning, operate together and at the same speed, as is the case with steam practice. In some more recent ferries, advantage is taken of the flexibility which electric drive permits to split the propelling motor into two distinct units each coupled to a propeller through a short length of shafting. The speed of the pulling (i.e. the forward) propeller can then be varied at will.

All the main and auxiliary machinery is situated in the center compartment of five into which the hull is divided by four watertight bulkheads. The main propelling motor, a 250 volt double armature shunt

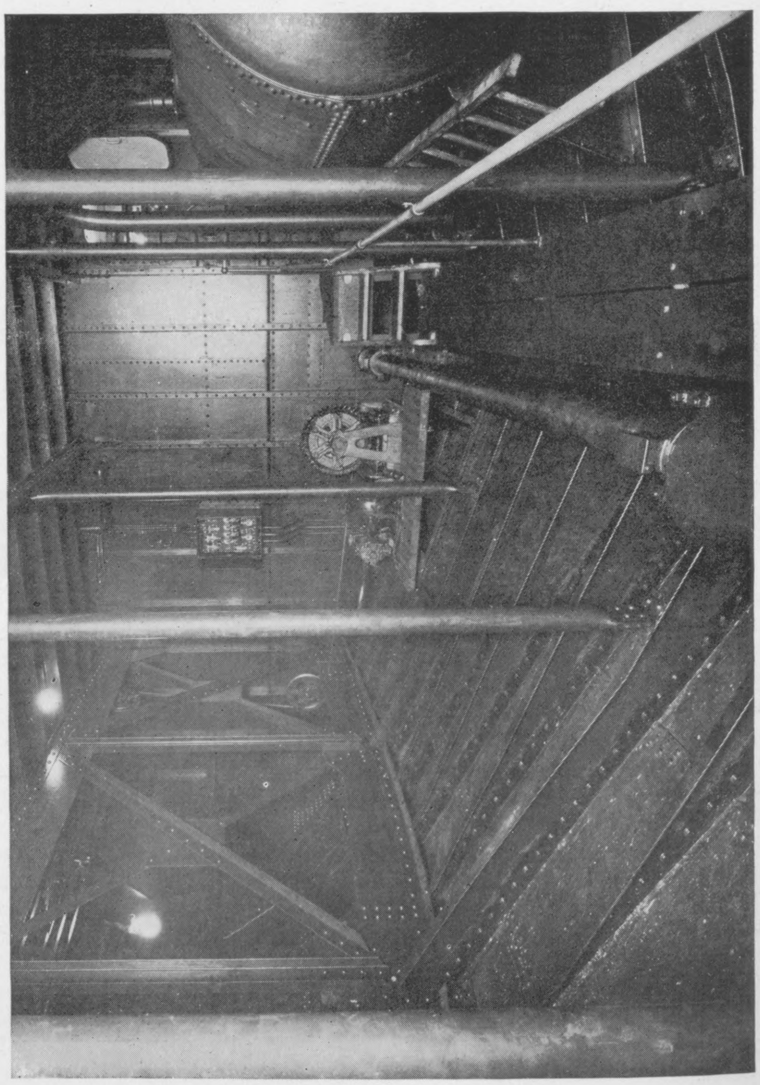
* See MOTORSHIP May and June issues for preliminary information.



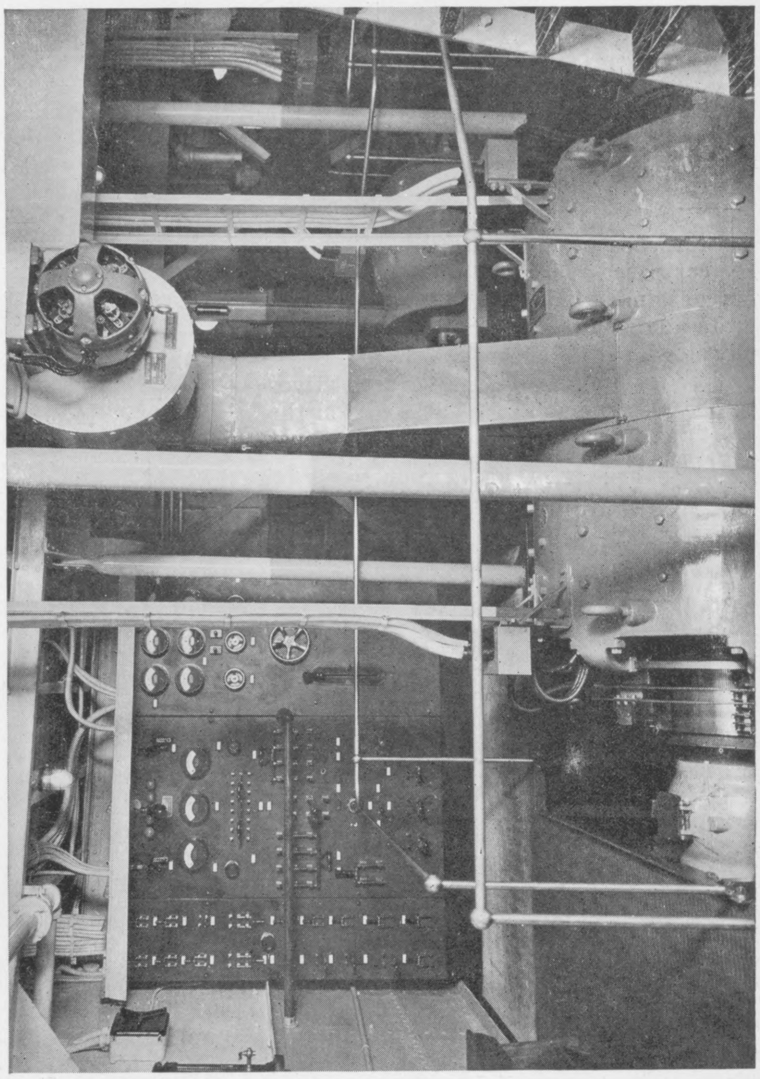
Steering is carried out normally by handle on small pedestal, control by telegraph



Two main generator sets are arranged fore and aft with main propelling motor between



Hull construction and arrangement in way of compartment adjacent to engine room

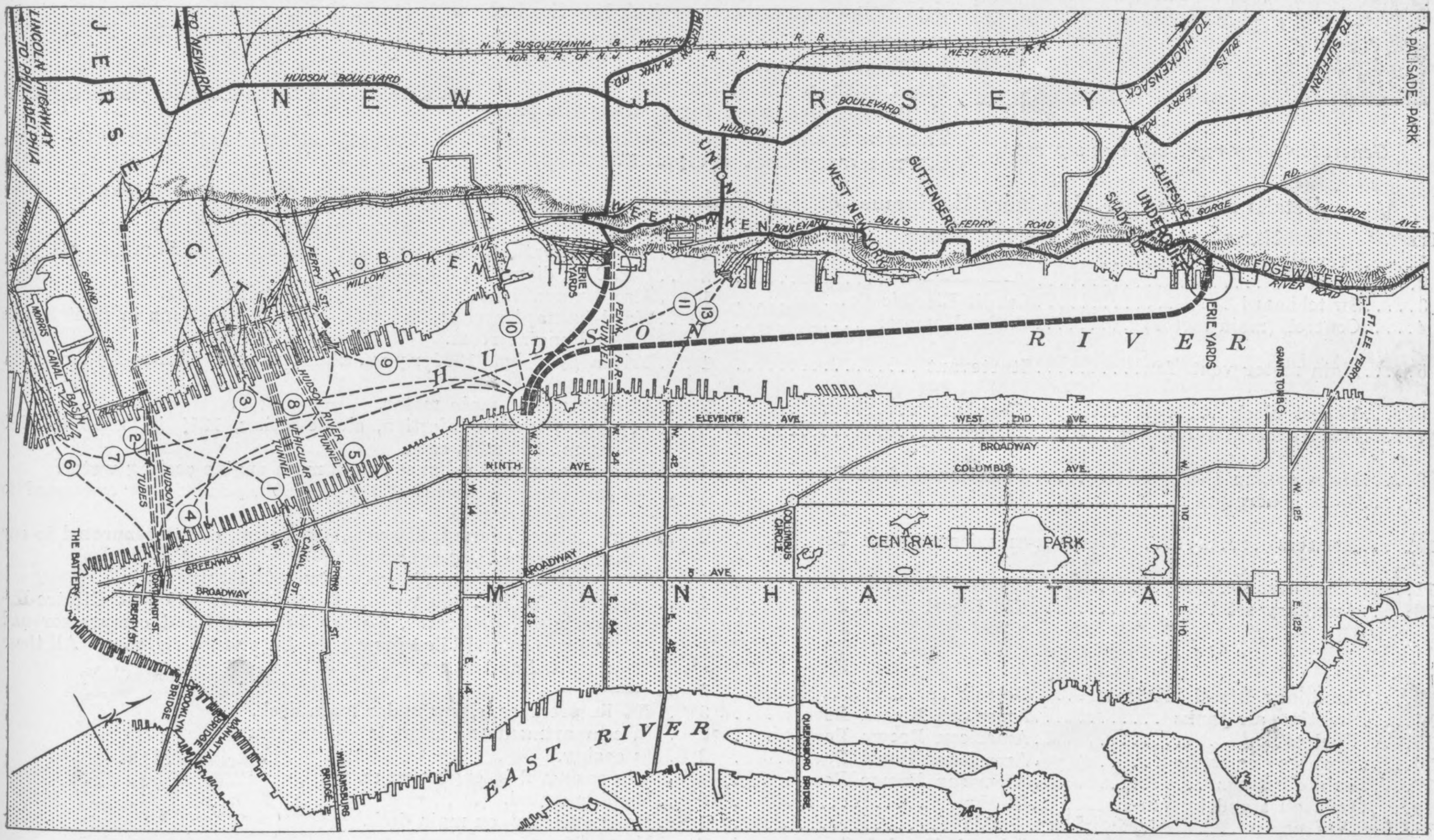


Main propelling motor, arranged in a pit, is totally enclosed and fan ventilated

wound unit, develops 580 s.hp. at 180 r.p.m.. and drives a 3-blade 7 ft. diameter wheel at either end of the ship. It is situated towards one end of the machinery space in a special pit below floor level and is carefully cased in to be immune from the effect of dirt. Ventilation of the motor is effected by a fan driven by a 2 hp. motor situated above the main propelling unit.

Current for main and auxiliary purposes when the vessel is in operation is supplied by two Diesel generators and exciters. The generators are 240 kw. d.c., shunt wound units and the exciters are 35 kw. d.c., compound wound units and both are mounted complete as one machine on the ship's structure direct connected to a 4-cycle, 6-cylinder, non-reversible, airless injection Diesel rated at 350 b.hp. at 280 r.p.m. The and when there is no electricity in the ship a 2-cylinder, 12 hp. Diesel-generator-compressor set is fitted and this also drives a rotary fire and bilge pump. The generator, which is direct connected, supplies current at 125 volts, and the compressor—a duplicate of that driven by the 7½ hp. motor—and pump are clutch connected, being thrown in or out as required. All these units are mounted on one base and arranged at one side of the engine room. They operate at 550 r.p.m.

The main switchboard of part open and of part dead front type, is arranged on the opposite side of the engine room to the auxiliary set. It contains the usual switches for the generators and exciters and also a control panel for the main propelling motor, so that if anything goes through reduction and worn gearing. The drum has wire rope connection through sheaves with a quadrant tiller on the rudder stock, under the main deck in the third watertight compartment. The tiller is also direct connected to a hand wheel by wire rope, the leads from the pilot house being down through pillar supports to the superstructure. Only one rudder is in operation at a time, the one not in use being held to the centerline by means of the usual pin stop. The rudders are of semi-balanced type and when centered are protected from any floating obstacle by the special construction of the stem bar. This is literally a stem bar of stereotyped form and the arrangement of the ends is, as far as we are aware, a special feature of Eads Johnson designed ferryboats. It differs considera-



Routes of New York's new Diesel-electric ferry service between 23rd St.and two new ferry terminals in New Jersey

main Diesels each drive their own cooling water, fuel oil, and lubricating oil pumps, in the latter case drawing from the engine sump and discharging into filter tanks in the casings—one for each engine. Two small stand by cylindrical lubricating oil tanks arranged on one of the bulkheads are capable of supplying any make up necessary by means of two hand-driven rotary pumps. The main fuel tanks, two in number, are situated one at each end of the ship in the compartment next the engine room. These are riveted steel circular tanks. The pumps on the main engine draw from these tanks into daily use fuel tanks—one for each engine—situated in the casing. The tanks are kept at a constant level.

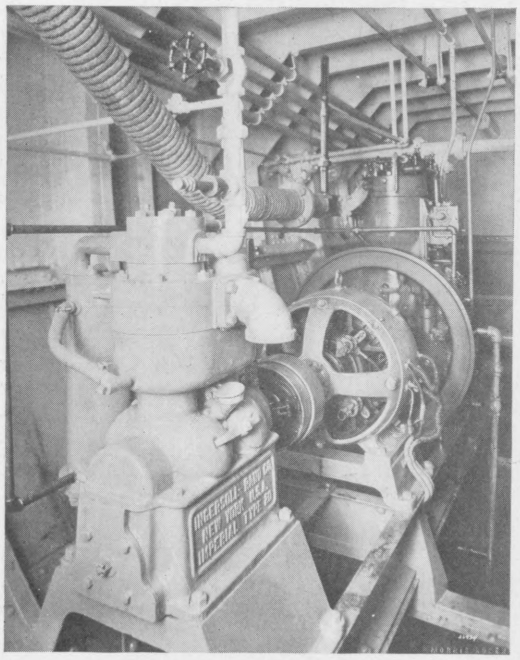
There are three circular tanks for starting air storage, and these are slung under the main deck and kept charged to 600 lb. per sq. in. by a compressor driven by a 7½ hp. electric motor. For stand by purposes wrong with the pilot house control maneuvering can be carried out from the switchboard in accordance with bell orders from the captain. The bridge control is of engine room telegraph type and is arranged to be operated by the pilot's left hand while his right hand moves the steering pedestal handle.

For steering, operated also by electricity, there is no wheel. A simple pedestal fitted with a street car controller type of handle is moved "left" or "right" as required. What could be simpler of more effective? Electric drive and pilot house control permit 100 per cent maneuvering ability to these new vessels.

There are two electric steering engines situated respectively in the compartments adjacent to the engine room. These consist of a 7½ hp. specially controlled motor—taking its direction of rotation from the pilot house pedestal—driving a drum bly from that found in most ferryboats and would seem to have much to recommend it.

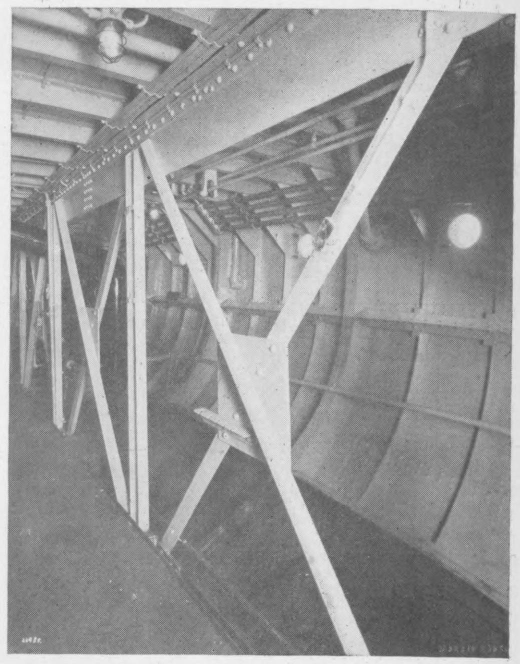
Regulations of the Steamboat Inspection Service require as an auxiliary to the electric gear a large diameter hand wheel of normal type, and this operates the rudder through wire rope attachments. The pilot houses also have a rudder angle indicator and a revolution indicator for the main motor.

The vessels are constructed of steel on the stereotyped frame and reverse frame principle. The main deck and superstructure top are of two thicknesses of wood. A fore and aft layer being superimposed on a thwart ship layer. The main deck has the usual stringer plates. Every fourth frame is a web frame and the floor width in these positions is continued up the ship's side. In the case of the ordinary frames a reverse bar is run along the floor top. There are two longitudinal truss girders, each



Generator-compressor-bilge pump set

between the two outer driveways, continuous between the second compartment bulkheads after which they are continued as ordinary longitudinals to the ends of the ship. There are also two ordinary longitudinal girders, with continuous face angles, on each side of the ship. These longitudinals together with the four watertight bulkheads give ample strength to the main hull. The main deck has an overhang of 5 ft. 9 in. on either side, supported by diagonal braces securely attached to the hull. The braces are replaced at the ends by brackets. The fender running round the edge of the main deck is entirely of steel. The main deck is entirely given over to vehicles and is covered by a light superstructure deck supported by pillars, the various casings, and the ship's side. The main deck space is partly enclosed on either side. The superstructure deck has the two stacks, side by side, taking the engine exhausts and the uptake of an oil fired boiler, fitted with a rotary burner operating at 80 lb. pressure, used for heating the ship. There are also the two pilot houses and the necessary boat equipment.



Truss girder and hull construction

Details of Principal Machinery Equipment of New York Diesel-electric Auto Ferries, 155 ft. 0 in. o.a., 580 s.hp.

ITEM	NAME	MAKE	QUANTITY	CHARACTERISTICS
1	Propelling motor	American Brown Boveri*	1	Double armature, 180 r.p.m., 250 volt, 580 s.hp., shunt wound.
2	Propeller	———	2	7 ft. 0 in. diameter, 3 blade.
3	Switchboard	Condit Electric Co.	1	Also for auxiliary control, Weston electric meters.
4	Control (main motor)	Cutler-Hammer	1	Ward-Leonard system, 250 volt, operating stations in pilot houses and engine room.
5	Main motor vent. fan	Sturtevant	1	Driven by 2 hp., 1300 r.p.m., shunt wound, Electro-Dynamic Co. motor.
6	Thrust block	Kingsbury	2	At each end of main motor.
7	Main generator engines	Nelseco	2	6-cylinder, airless injection, single-acting, 12¼ in. x 18 in., 280 r.p.m., 350 s.hp. each.
8	Main engine thermometers	American S. & B. Corp.	4	On each engine, 2 exhaust gas, 2 main engine cooling water.
9	Main generators	American Brown Boveri*	2	240 kw., direct current, 250 volt, 180 r.p.m., direct connected to one main engine.
10	Exciters	American Brown Boveri*	2	35 kw., direct current, 250 volt, 180 r.p.m., direct connected to one main engine and generator.
11	Compressor	Ingersoll-Rand	1	2-stage, motor driven, 7½ hp. motor, 600 lb. per sq. in.
12	Auxiliary set	Hill Diesel	1	2-cylinder, 12 hp., 550 r.p.m. Diesel drives 125 volt Electro-Dynamic Co. generator, 2-stage Ingersoll-Rand compressor and rotary fire and bilge pump, two latter thro clutches. All these mounted as one set.
13	Auxiliary Diesel lubricator	Detroit	1	———
14	Starting air tanks	American Brown Boveri	3	600 lb. pressure, slung under main deck.
15	Fuel tanks	American Brown Boveri	2	In compartments adjacent to engine room.
16	Fuel service tanks	American Brown Boveri	2	In casing.
17	Lub. oil tanks	American Brown Boveri	4	2 in casing, 2 in engine room.
18	Lub. oil stand by pump	Blackmer	2	Hand operated.
19	Fire pump	Goulds	1	Hand operated, on main deck.
20	Compass	John E. Hand & Son	2	Normal type.
21	Steering engine	American Eng. Co.	2	Motor driven thro gearing, motor 7½ hp. at 850 r.p.m.
22	Heating boiler	American Radiator	1	80 lb. pressure, burns oil on Ray's Rotary system.
23	Oil burning system	Ray	1	Driven by Westinghouse motor, delivers 3 gal. per hr.
24	Engine room gratings	Irving Ironworks	2	2 sets in casings.
25	Valves on starting air system	Williams	—	———

* Built by American Brown Boveri in conjunction with Electro-Dynamic Co., Bayonne, N. J.

Tampa's Conversion Cost

(*Continued from page* 923)

This work has cost $125,000, and is chargeable against improvements in the vessel, but is not inherently a part of the power conversion. It has made TAMPA a better vessel, but could just as well have been undertaken when TAMPA was a steamer.

One more item remains to be considered, and its introduction is almost ironical because it is charged by a Government department for work which is practically never mentioned in connection with private contracts and which the business world nevertheless holds that Government bureaus habitually neglect—as many of them do in point of fact. This item is the "overhead" of the engineering work, purchasing, inspection, travel expense, freight incidentals, trial trip and other extras, forming a total of $23,000 in the case of TAMPA.

Summarizing therefore, it may be stated that $51,000 were spent on repairs and outfitting, $125,500 on betterments for particular route, $541,022 for conversion to Diesel power with electrical equipment and $23,000 for staff and minor expenses. For this expenditure the Shipping Board now has a very serviceable and efficient transportation unit.

Naval Architects Meetings

The 34th general meeting of the Society of Naval Architects and Marine Engineers was held in New York on Thursday and Friday, Nov. 10 and 11. A comprehensive range of papers was presented for discussion and covered such subjects as the possibilities of the Flettner Rudder; engineering aids to navigation—a matter whose importance MOTORSHIP has frequently stressed. Brig.-Gen. T. Q. Ashburn rendered useful service by discussing the conditions governing the selection of a fleet for the Upper Mississippi River, while the remarks on performance tests on Diesel-electric stern-wheel towboats contributed by Mr. C. H. Giroux are of value to the industry at large. The technique of ferry-boat design, and particularly the question of the application of the Diesel engine to this type of ship received a helpful contribution in the paper presented by Professor Gross and Mr. Green.

War Department to Build New Ferryboat

Will Consider Straight Diesel and Diesel-Electric Layout Bids for Vessel for New York-Governor's Island Service

STRAIGHT Diesel propulsion and Diesel-electric drive for about 500 s.hp. with pilot house control are both to be considered in bids which War Department will open on December 14 for the construction of a steel double ended ferryboat. The vessel is to be operated in New York harbor between The Battery and Governor's Island.

Design requirements in the vessel call for much that is progressive and in line with modern practice, and the arrangement of accommodations, driveways, etc., has been very cleverly laid out considering the comparatively limited dimensions on which they have to be arranged.

The vessel is to have two driveways on either side of a center casing each 10 ft. 0 in. wide. The center casing is 4 ft. 6 in. wide and the remainder of the space between the driveways and the ship's side is occupied by passenger space. Further passenger space is arranged above the superstructure deck—known as the upper deck—while above this again is a shade deck containing stack, pilot houses and boats. The total height of the ship from base line to top of shade deck at side is just over 34 ft. overall.

Characteristics of New Army Ferryboat

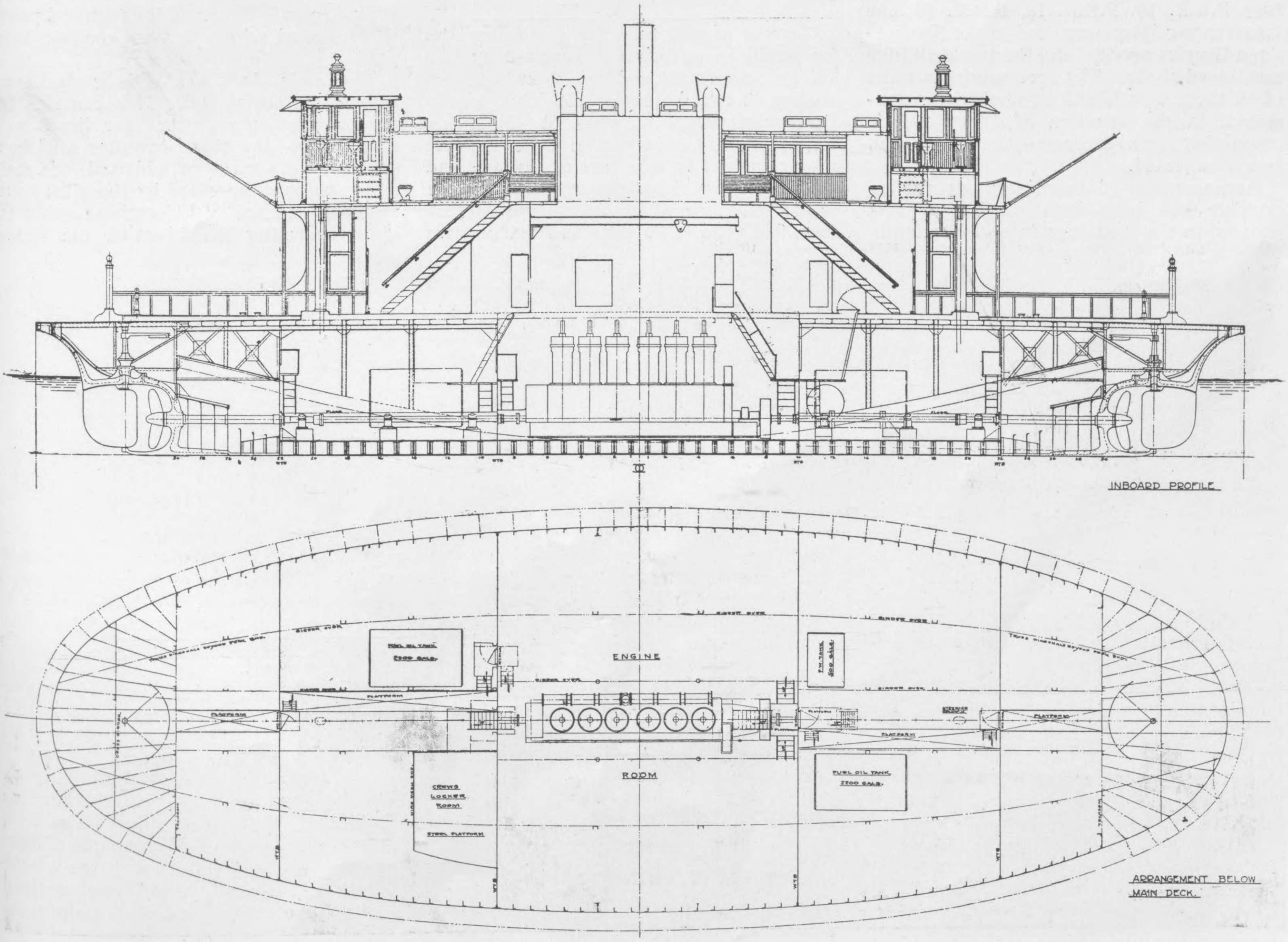
Length over guards	132 ft. 0 in.
Length on 8 ft. 6 in. w.l.	121 ft. 8 in.
Breadth over guards	46 ft. 0 in.
Breadth of hull at deck, molded	42 ft. 0 in.
Breadth of hull on 9 ft. 0 in. w.l	36 ft. 2 in.
Depth of hull at side, molded	14 ft. 6 in.
Depth of hull at center, amidships	14 ft. 11 in.
Depth to top of guard face plate (about)	14 ft. 6 in.
Draft in light service condition	8 ft. 6 in.
Power	500 s.hp.

The midship section outline shows a sharp rise of floor in conjunction with a well rounded bilge which sweeps into a well defined flare out to the guard face plate. The flared midship section is probably of considerable advantage, from the point of view of stability, in a structure with dimensions such as those outlined above.

Frame and reverse frame method of construction is adopted, 5 in. x 3 in. x 3/8 in. angles being spaced 22 in. between peak bulkheads and 17 in. between peak bulkheads and transoms. Web frames are suitably interspersed between the ordinary framing and these, outside the two fore and aft truss girders, are 12 in. depth. There is a flat plate keel and a vertical center keelson. The upper deck edge is radiused 14 in. and plated over the round. Four watertight bulkheads divide the hull into five compartments—a center machinery compartment, two compartments adjacent containing fuel oil tanks, and two peak compartments. The ends of the ship are of "clipper" type and the rudders are of semi-balanced type.

The main propelling machinery is to be a 4-, 6-, or 8-cylinder single- or double-acting 2-cycle or 4-cycle Diesel developing about 500 s.hp. at about 200 r.p.m. The piston speed is not to exceed 800 ft. per min. and the m.e.p. is not to exceed 80 lb. per sq. in. The Diesel is pilot-house controlled.

The Diesel-electric proposition calls for two Diesel generators each rated 180 kw. and 250 volts. The bidder is left a choice in the arrangement of propelling motors and can put forward either one motor connected through to the propeller at each end rated approximately at 450 b.hp. at from 180 to 200 r.p.m. or two motors—one at each end—each rated at 450 b.hp. at 180 r.p.m. and controlling its own propeller.



Propositions for a ferryboat with direct Diesel machinery layout of 500 s.hp., with pilot house control, are being asked by the War Department

Double Ended Diesel-electric Towboats

P.R.R. Has First Vessels of This Type Now in Service as Drill Tugs Working in Jersey City Slips

PENNSYLVANIA RAILROAD has recently placed on service in New York harbor two Diesel-electric drill tugs which represent the most constructive application of electricity to railroad towboats yet attempted. Built so as to be exactly alike at both ends with propeller and rudder at either end, and with practically no parallel middle body, the two vessels are able to maneuver either "ahead" or "astern" with the greatest of ease and their main propelling motor can be thrown over from 125 r.p.m. in one direction of rotation to 125 r.p.m. in the opposite direction in the mere matter of 6 sec. by the watch. This high degree of maneuvering ability is ideal for the work in which they are engaged—moving barges from one berth to another between two piers, or from one dock to the next—and no time is lost in turning round such as is inevitable with the single ended ship engaged in this work. When to this is added the economy of operation of Diesel-electric propulsion, it will be realized that the Marine Power Department of the Penn. R.R. has contributed very materially to progress with its two new ships.

Diesel-electric towboats in the Pennsylvania fleet now number six—three float tugs P.R.R. 16, P.R.R. 18, P.R.R. 26, one transfer tug WICOMICO used in the Norfolk-Cape Charles service, and the two drill tugs mentioned above. The successful operation of all these vessels will no doubt be instrumental in the selection of Diesel-electric propulsion for new construction when such is contemplated.

Arrangement of machinery as far as possible has been kept similar to that adopted in the float tugs in order to familiarize crews and to render them interchangeable among the various boats. The main propelling motor which gives 250 s.hp. at 125 r.p.m. is of double armature type situated near one end of the boat and coupled direct through two thrust blocks to a 7 ft. 0 in. diameter, 6 ft. 6 in. pitch wheel at either end of the boat. This motor which is controlled normally from one of two inter-connected telegraph-type controllers in the pilot house can also be operated from a special control panel on the switchboard arranged at one end of the deckhouse. This switchboard is of dead front type similar to those used on the other ships.

Characteristics of Drill Tugs

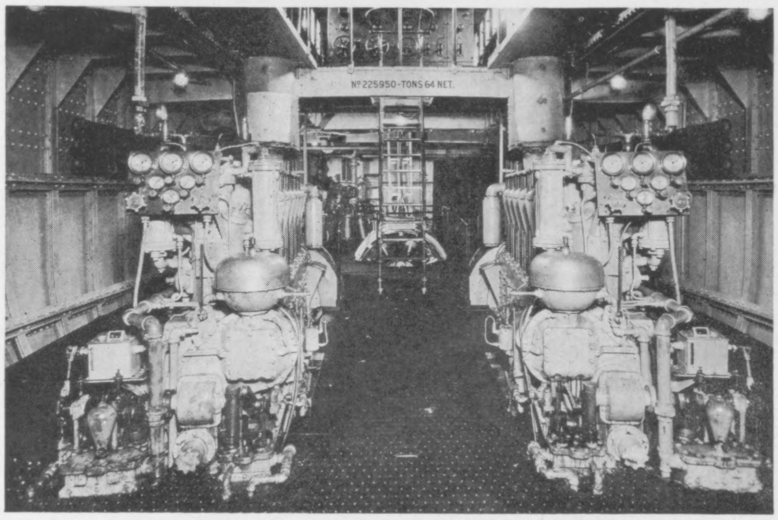
Length o. a.	80 ft. 0 in.
Beam, mld.	19 ft. 0 in.
Depth, mld.	12 ft. 6 in.
Depth at ends	13 ft. 6 in.
Camber of deck	0 ft. 4 in.
Rise of floor	1 ft. 6 in.
Height of floors	2 ft. 10¾ in.
Flat of keel	nil
Frame spacing	21 in.
Rake of shafting	nil
Center line of shafting above keel bottom	4 ft. 0 in.
Net tons	64
Power	250 s.hp.

Current at 250 volts for propulsion and for auxiliary purposes is supplied by two 105 kw. generators and two 15 kw. exciters coupled to two 6-cylinder 150 b.hp. 4-cycle Diesels operating normally at 450 r.p.m. When the ship is in operation the exciters supply current to take care of lighting and other auxiliary requirements including a motor generator which transforms current from 250 volts to 80 volts and charges two sets of five storage batteries. The main Diesels are entirely self contained and operate their pumps for fuel, cooling water and lubricating services.

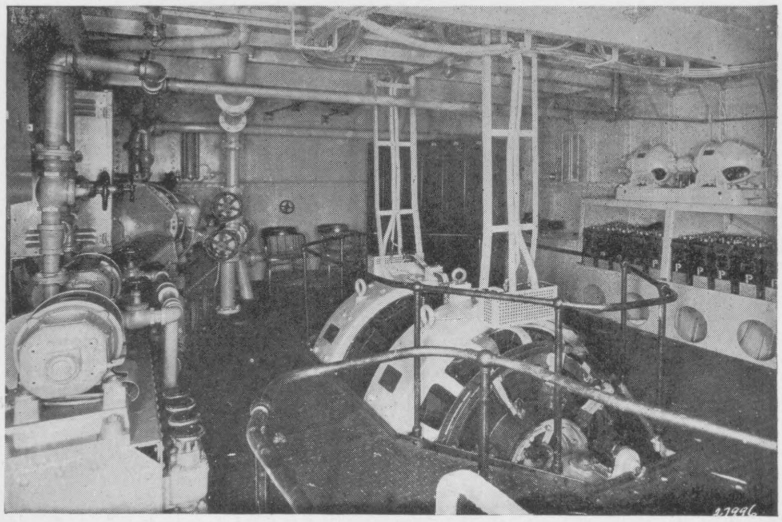
The only pump equipment necessary in the engine room therefore is a powerful centrifugal fire pump, and a pair of bilge pumps. The fire pump, situated alongside the propelling motor on the opposite side of the vessel to the motor generator, is of centrifugal type, motor driven and arranged to discharge from a monitor on the pilot house top. It is a duplicate of the corresponding unit fitted in the other Diesel-electric tugs in the P.R.R. fleet. The two bilge pumps are also motor driven, being of positive displacement rotary type. The engineroom bulkhead nearest to the generators has six starting air bottles arranged vertically on either side of a manhole giving access to a compartment containing one of the two fuel tanks; there is a similar compartment at the other end of the ship. On this bulkhead there is also a lubricating oil filter tank and two fresh water tanks. There are four electric heaters arranged in the engineroom and two steam heating coils which can be coupled up to a shore line when the ship is not running. The engine room is clear and the required power is generated within a very compact compass.

The main deck has a long deckhouse rounded at either end. This contains the necessary accommodations for the 8 hour shift crews—the vessel operates a 24 hour schedule—the main switchboard, the main motor rheostat operated by the pilot house controls, and the two electric steering engines operating the tiller on the rudder

Double ended towboat P. R. R. No. 15 features the latest development in drill tug design and represents the acme of maneuvering ability



Generators and motor make neat engine room layout



Main propelling motor, pumps and batteries are "aft"

head. The steering arrangement is one of the most novel features in the design. In order to secure maximum maneuvering ability both rudders and both steering engines operate at one time from one of two steering wheels in the pilot house. By this means the ships can practically spin in their own length if necessary. The fact that both rudders operate at once gives the ship tremendous flanking power with a heavy barge alongside.

Synchronization of rudder movement is obtained by connecting the two steering engine motor controls and this is accomplished by means of a fore and aft rod running under the pilot house floor. On the other hand, if there is ice about it may be unwise to risk damage to the particular rudder which is the "forward" rudder at the time and consequently it is arranged to throw either rudder out of operation by means of a clutch connection in the pilot house to the fore and aft control rod. The rudder in question must first be brought to 'midships. Without the clutch it would be necessary, every time a rudder was put out of operation, to send a man down to "pin" the rudder as in the case of a double ended ferryboat. If the rudders were not synchronized, this operation would be necessary every time a reversal of direction of motion was made. In this the double ended towboat differs from the double ended ferryboat because in the latter reversals of motion are only made in the slip while in the former they are going on all the time.

The pilot house is placed amidship and is of flat oval type with windows all around and a door at either end. The equipment here comprises the two inter-connected motor controls and two full sized steering wheels. The motor controls are operable for either direction of motion but a different wheel is used for differences in directions of motion, the "forward" steering wheel being used in each case.

The pilot house top contains the fire fighting monitor, compressed air syren and two-way sidelight racks. The sidelights are changed by quick change switches operated when the "forward" steering wheel is used. Exhausts from the two Diesels are led up each side of the pilot house and terminate about 18 in. above the house top.

The hull is constructed on the usual towboat principle with frame, reverse frame, and floors. The fenders are of steel similar to the pattern adopted on most recent towboats of the P.R.R. There is no tumble home. Two watertight bulkheads divide the hull into three compartments. The hulls of these vessels were constructed by the Newport News S. B. & D. D. Co. and the whole of the fitting out was carried out at the P.R.R. shops, Hoboken, N. J.

Machinery Equipment of Double-ended Diesel electric Drill Tugs for P.R.R., 80 ft. o.a., 250 s.hp.

Item No.	Name	Make	Quantity	Characteristics
1	Propelling motor	Westinghouse	1	Open, double armature, 125 r.p.m., 250 volts per armature, 250 s.hp.
2	Propeller		2	7 ft. 0 in. diameter, 6 ft. 6 in. pitch.
3	Switchboard	Westinghouse	1	Ebony asbestos, 5 panel.
4	Main engines	Winton	2	6-cylinder, single-acting, 150 b.hp. each.
5	Main generators	Westinghouse	2	105 kw., direct current, 250 volt, 450 r.p.m., each direct connected to one main generator.
6	Exciters	Westinghouse	2	15 kw., direct current, 250 volt, 450 r.p.m., each direct connected to one main generator.
7	Fire pump	Gould	1	Centrifugal, 60 hp. motor, 1750 r.p.m.
8	Fire pump main valve	Lunkenheimer	1	....
9	Fire pump gauges	U. S. Gauge Co.	.	100 lb. per sq. in. pressure.
10	Bilge pumps	Blackmer	2	Positive displacement, rotary, 3 hp. motor, gear driven.
11	Motor generator	Westinghouse	1	3½ kw., for supplying lighting current direct or for charging batteries.
12	Storage Batteries	Edison	2	2 sets, 32 volt.
13	Steering gear motors	Westinghouse	2	2 hp. with brake device.
14	Main engine thermometers	Standard Therm. Co.	.	....
15	Main motor controls	Chas. Cory	2	Telegraph type, inter-connected.

Gripsholm Sistership to be Built in Germany

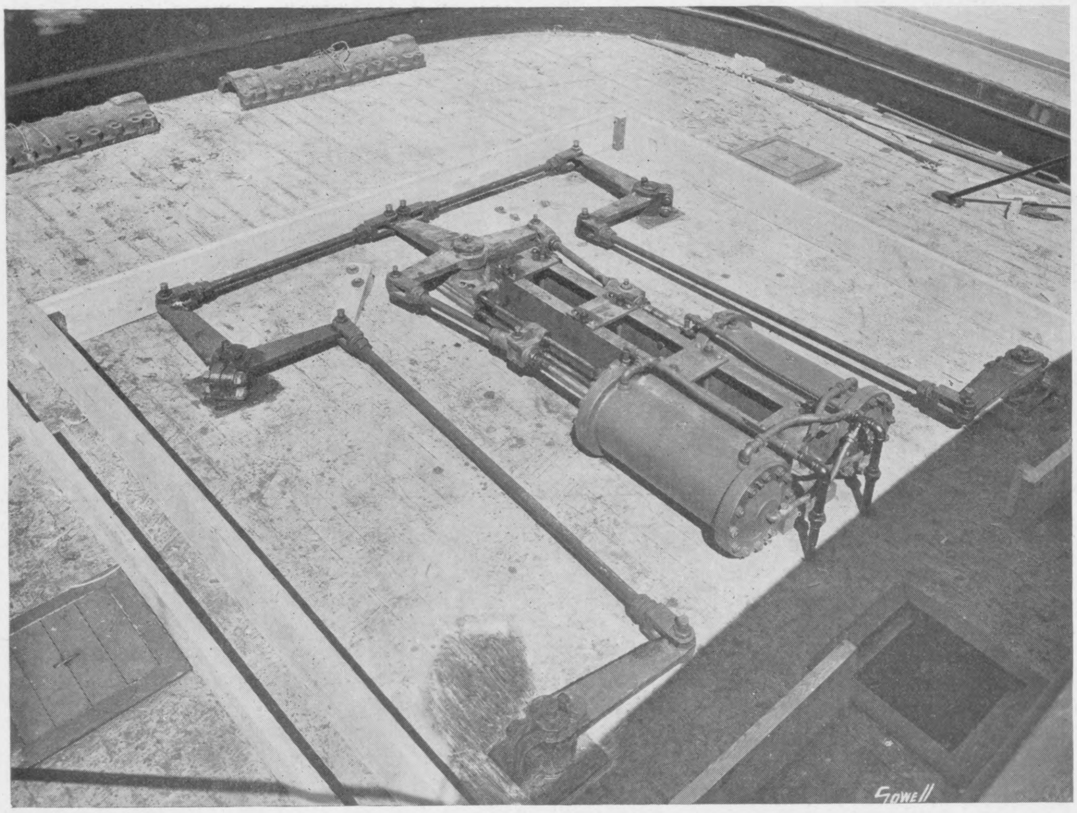
Successful operation of ms. GRIPSHOLM, first transaltantic passenger motorliner which has been in commission nearly a year, has been so marked that the directors of the Swedish American Line have for some time had under consideration the construction of a sister vessel. Various firms have been mentioned in connection with this proposed construction but it is only comparatively recently that the award has been made.

Blohm & Voss, Hamburg, are to construct the sister vessel, and will deliver her for service on Nov. 1, 1928. The new ship will be 580 ft. in length and will have two B. & W. double-acting 4-cycle Diesels totaling 15,000 b.hp., of the same type as those fitted to GRIPSHOLM. The construction of the main and auxiliary machinery is, we understand, to be distributed between the Burmeister & Wain Works, Copenhagen, and the Götaverken works at Gothenburg.

The general layout and passenger accommodations will be along the same lines as those of the GRIPSHOLM. With these two large fast motorliners, the only large vessels of this type operating on the North Atlantic, the Swedish American Line will make a strong bid for the American tourists traffic to Scandinavia and Northern Europe.

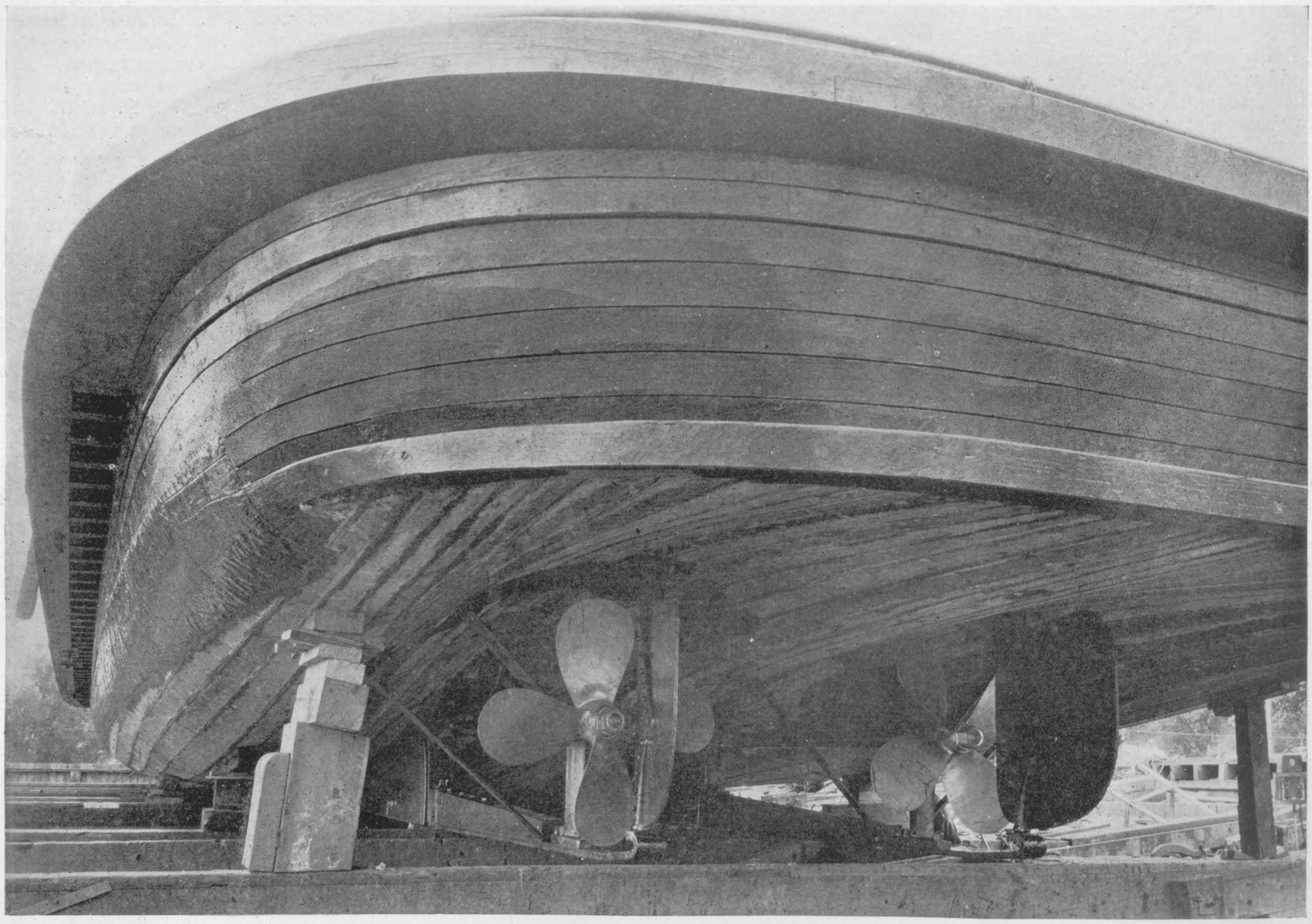
Like GRIPSHOLM the new vessel will be admirably suited for cruising.

Ms. SECUNDUS, 7500 tons d.w. motorship built by Blohm & Voss, Hamburg, in 1913, powered by 2-cycle Diesels of 2600 hp., and until recently owned by A. Vimont & Co., has been sold by auction in New York by order of the Admiralty Marshal for $95,000. This vessel was taken over by the French after the war and was intended to act as a training ship for young French Diesel engineers. She has had a series of misfortunes with her propelling machinery.

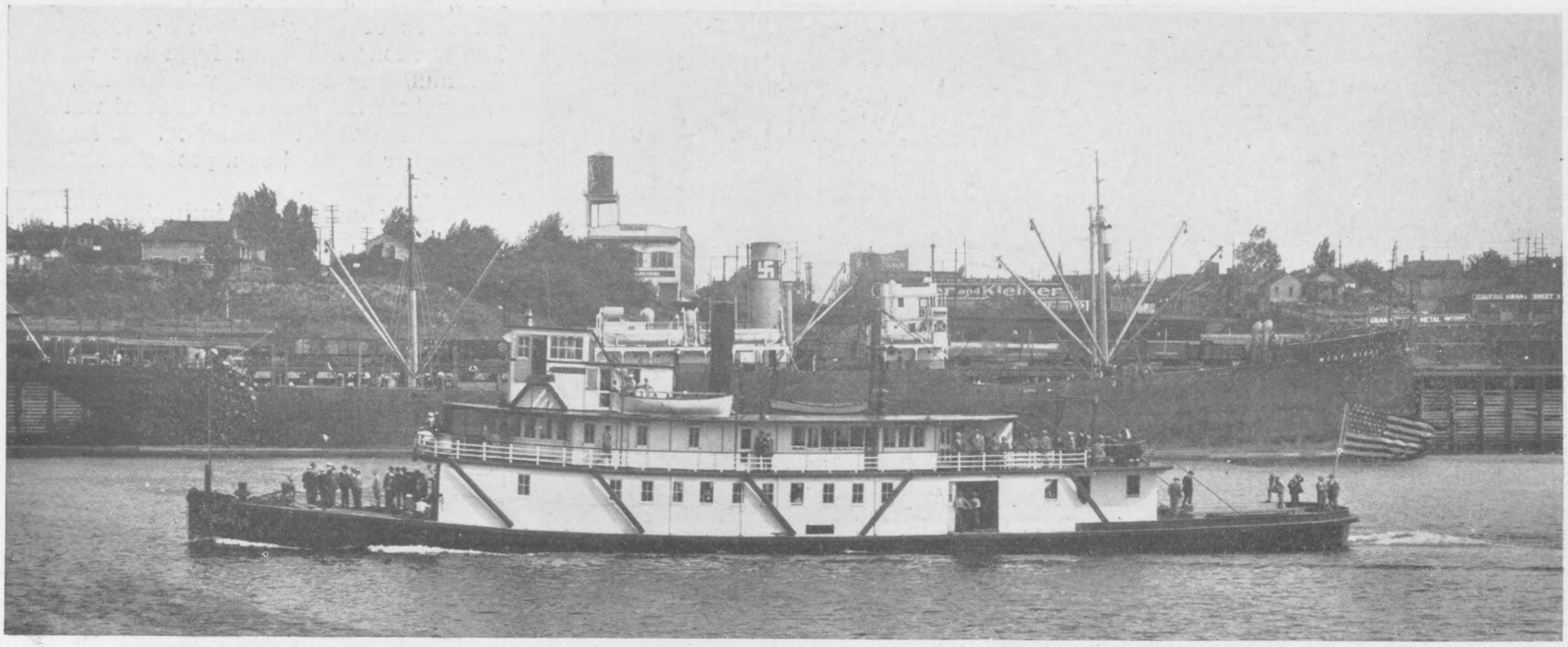


Towboat Shaver Converted from Steam Has Entirely New Stern With Twin Screws and Quadruple Rudders

Special pneumatic steering gear is fitted to deal with the operation of four rudders



Conversion of the Columbia River towboat Shaver involved the new construction shown above which includes the fitting of propellers and rudders



Ms. Shaver, a Columbia River towboat, converted from steam and fitted with two Diesels of 750 collective hp., direct coupled to propellers

Marking a New Era on Columbia River

Shoal Draft Towboat Shaver Is Converted from Stern Wheel To Twin Screw Direct Drive and Dieselized

MODERNIZATION of the 18 year old stern wheel Columbia River towboat SHAVER has recently been brought about by the substitution of Diesels for a steam plant which had seen service in the Civil War. A further transformation has been effected by removing the stern wheel and building on an entirely new stern with semi-tunnels in which two screws operate. Each screw has a rudder directly behind it and two small auxiliary rudders have been built on the center line of shaft forward of the propellers. No compromise has been made in arranging the drive such as might easily have been done by operating the sternwheel by the Diesels through gearing or belting such as is done in Western river pushboats. The use of a straight screw drive is indicative of the fact that Shaver Transportation Co., the vessel's owners and one of the leading concerns of the kind on the Pacific Coast, is convinced of the suitability of using the screw for log towing work in shoal water which will be the vessel's principal work.

Two difficult problems had to be faced by the engineers when plans for the conversion were worked out. One was to preserve the shallow draft taking into account the large diameter propellers necessary for towing work and the other was to make the boat easy to maneuvere. In addition, it was necessary to make several structural changes to enable the old hull to carry the added weight of the Diesel plant successfully.

The problem of preserving the shoal draft without impairing maneuvering ability was solved by the use of a special semi-tunnel stern, worked out by Capt. Homer Shaver in collaboration with J. H. Johnston, naval architect and marine engineer of Portland.

Characteristics of Towboat Shaver

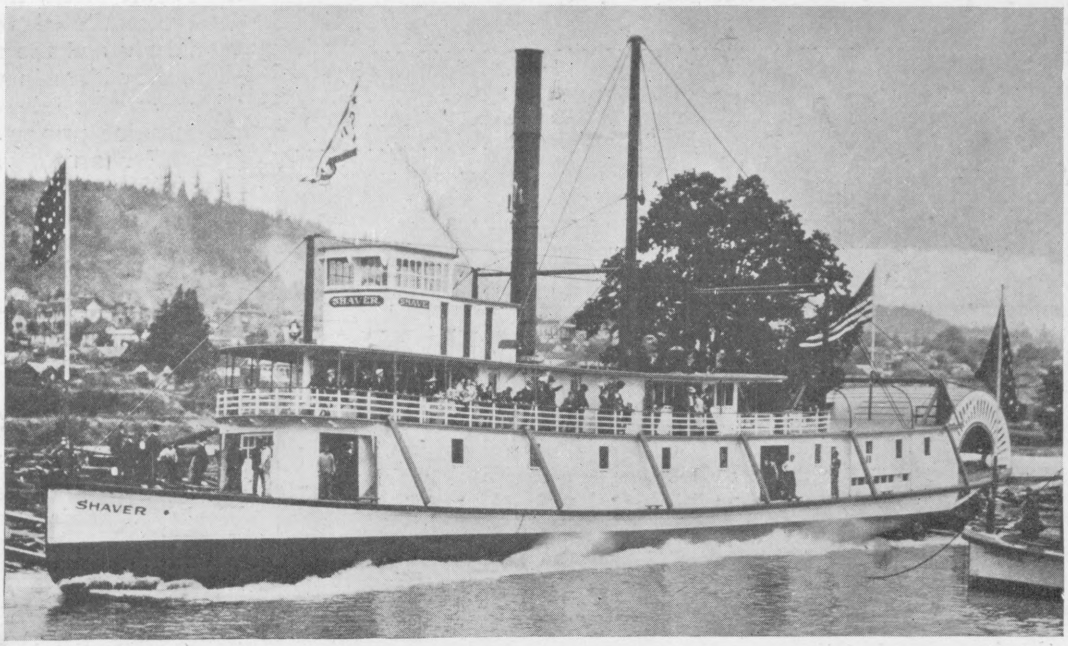
Length b.p.	155 ft. (approx.)
Beam, molded	30.8 ft.
Depth, molded	7.8 ft.
Power	750 b.hp. (total)
Speed (light)	11¾ m.p.h.

Easy maneuvering, especially when backing up, was attained by the use of four rudders. Two main rudders are installed aft of the propellers and two "monkey" or auxiliary rudders just forward of them. This arrangement caused the propeller streams to act immediately upon the rudder plates. The rudders are controlled by a special pneumatic steering gear, a device which still further simplifies the problem of steering and maneuvering. The combined rudder area is about 100 sq. ft. Heavy engine timbers 70 ft. long with 14 in. by 21 in. section were installed to take the weight of the engines. In addition the hull was strongly braced amidships with additional frames. The old cylinder keelsons were left in the boat and the old transom provided additional stiffening.

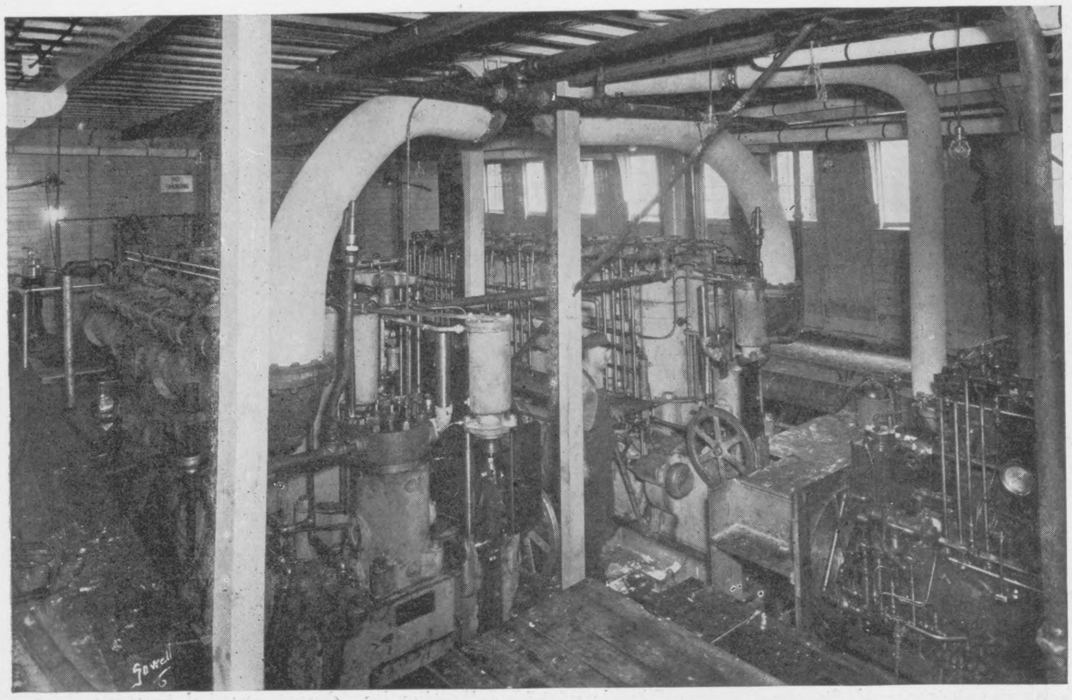
SHAVER'S two main engines, 6-cylinder 375 b.hp. Atlas-Imperial Diesels, each turn a 4-blade towing propeller 5 ft. 8⅞ in. in diameter and 70 per cent pitch ratio, designed and built by J. H. Johnston of Portland.

On trial trip SHAVER made 11¼ m.p.h. with the engines turning at 260 r.p.m. The propellers were specially made for towing logs and naturally cannot make speed running light. The owners are well pleased.

The central power units are controlled and operated entirely from a maneuvering station at the aft end of each engine. There is a single reversing and control lever on each engine and the controls are so located that the engineer may handle both engines at the same time without



Shaver, at the time of her launch 18 years ago was typical of old style towboats



Ample space is available for the installation of Shaver's two main Diesels

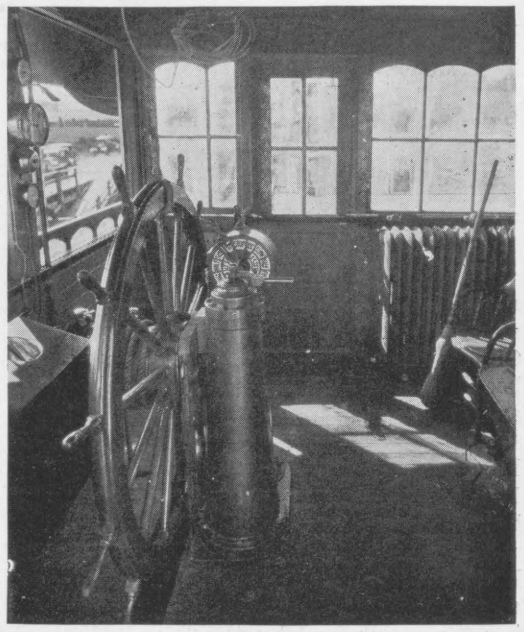
moving from his position. Reversing is automatic with the handling of the control lever. A standard engine room telegraph has been installed for transmitting signals from the pilot house. Each engine is equipped with two sump pumps, two pressure lubricating pumps, two fuel oil transfer pumps, and four high pressure fuel oil pumps, the latter furnishing fuel oil to the cylinders at 3500 lb. pressure. All these pumps are assembled in one group and are easily accessible.

Immediately forward of the main propelling units is a 3 cylinder 50 hp. Atlas-Imperial Diesel engine with the center cylinder arranged as an air compressor, to furnish air for the steering gear and other air driven auxiliaries with the main engines shut down. When the main engines are running, the compressors on the forward end of each unit furnish ample air for all purposes. The auxiliary Diesel also drives a 10 kw., 125-volt generator charging two 12-volt storage batteries for use in supplying the running lights when the main engines are not in operation. For operating the other lights of the boat, including a 30-amp. searchlight and six large flood lights, there is a 7½ kw. generator driven from the shaft of the port main engine. A 3 hp. gasoline driven auxiliary has been installed for operating an emergency compressor to furnish starting air for the 50 hp. auxiliary generator-compressor set.

Two main circulating water pumps are driven by sprocket chains from the main Diesels. These are 6 in. by 12 in. pyramid plunger units. There is also a 5 in. by 6 in. pump on the intermediate shaft of each of the main engines, one used for a bilge pump and the other for the sanitary lines. The pumping equipment is complete by a 6 in. by 12 in. plunger pump, driven off the auxiliary engine, which can be used for fire, circulating water, sanitary or bilge lines, enabling any one to take over the functions of the others in an emergency. The suctions are taken from two wells in the hull, one forward and one aft, thus eliminating the danger of lack of water in case of the vessel grounding. A DeLaval oil purifier is fitted as a protection against faulty lubrication.

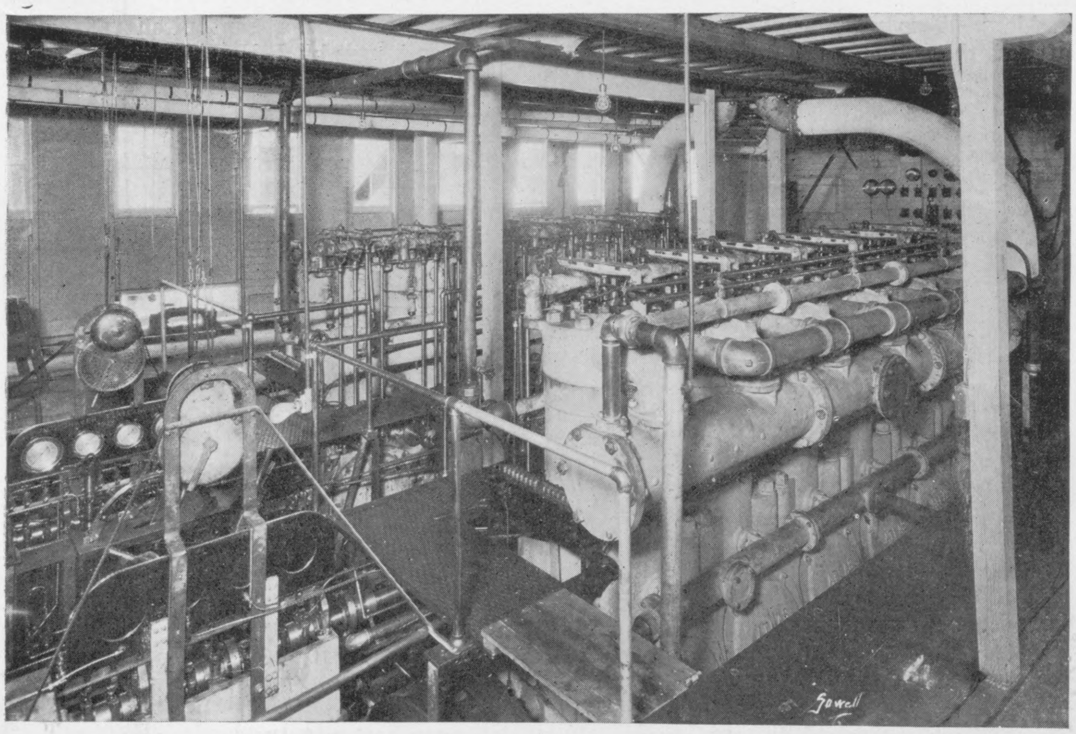
All deck auxiliaries, including the capstan forward and the towing machine on the superstructure aft, are operated by compressed air, an 8 in. by 10 in. steam plant having been overhauled for this latter purpose. Compressed air is stored in the engine room. The tug is heated by a hot water system supplying the eight radiators.

The question of rapid maneuvering has been in great measure solved by the Johnston-Fries pneumatic steering gear installed on the after deck with controls carried to the pilot house. This gear is so sensitive that a very slight movement of the lever in the wheel house will keep the tug on her course. While the regular gear consists of two cylinders placed parallel to each other each bolted to a channel iron frame with guides, crosshead, and connecting rods attached directly to the tiller arm on the rudder stock, the use of the four rudders necessitated the working out of a special rig and the necessity for operating all four rudders in unison involved the installation of a false rudder stock to which the machine proper is connected by a "T" type tiller arm through connecting rods. Connecting rods attached to the aft end arm of this tiller join the two main rudder stocks to the steering engine by bell crank tiller arms, which in turn are connected to the tillers on the auxiliary or "monkey" rudders by 2 in. round steel connecting rods and cast steel fork ends.

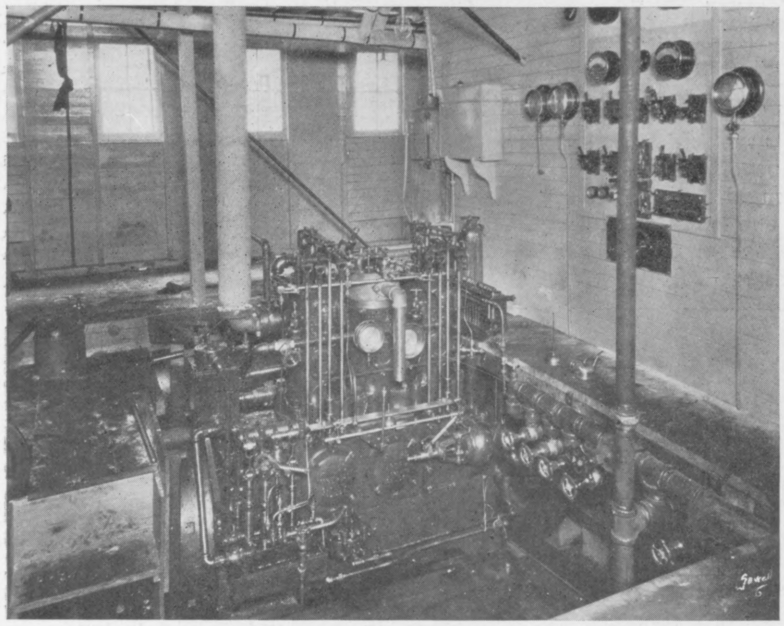


New pedestal steering control

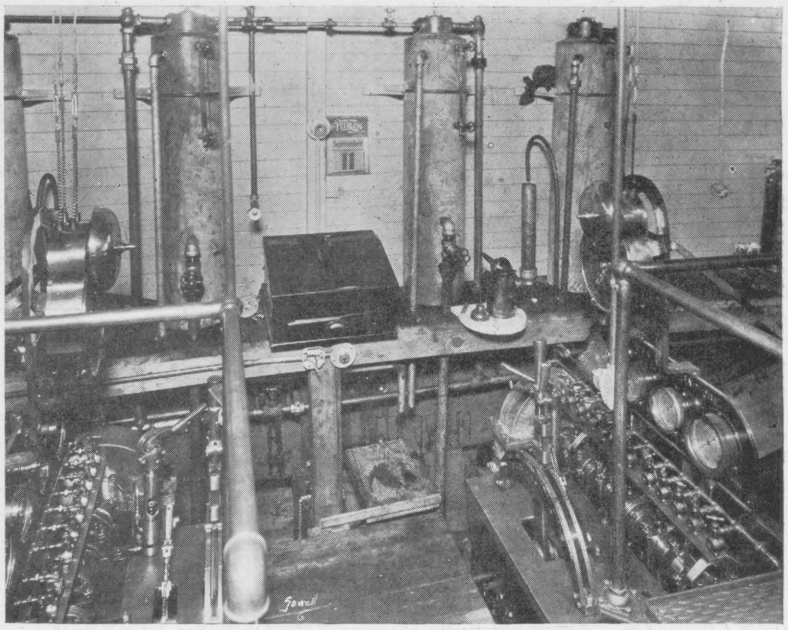
The gear uses a double acting type cylinder 12 in. in diameter by 35 in. stroke. There is always an air cushion in each end of the cylinder to take up the shock of rough handling and eliminate the possibility of breakage. This gear in maneuvering on the trial was handled from hard over to hard over in 5 sec. and is entirely noiseless in operation. The work of conversion was carried out by the Portland Shipbuilding Co., Portland, Ore.



Control station is arranged at the aft end of the two main engines



Auxiliary generator and compressor set



Main engine controls and wheelhouse telegraphs

Details of Principal Machinery Equipment of Twin Screw Tunnel Stern Towboat Shaver, 750 b.hp.

ITEM NO.	NAME	MAKE	QUANTITY	CHARACTERISTICS
1	Main engine	Atlas-Imperial	2	6 cyl., airless injection, single acting, 250 r.p.m., 375 b.hp.
2	Propeller	Johnston	2	5 ft. 8⅞ in. diameter, 4 blades, pitch ratio 0.7.
3	Aux. engine	Atlas-Imperial	1	3 cyl., airless injection, single acting, 50 hp., center cylinder arranged as a compressor, drives a generator.
4	Main generator	G. E. C.	1	10 kw., 125 volt.
5	Aux. generator	Westinghouse	1	7½ kw. driven off shaft of port engine.
6	Storage batteries	Edison	2	12 volt, charged by 7½ kw. generator.
7	Emergency compressor		1	Gasoline engine driven.
8	Comp. air storage	Atlas	8	Bottles 30 in. diameter by 8 ft. 0 in. long.
9	Searchlight	Carlisle & Finch	1	30 amp. on pilot house top.
10	Circ. water pumps	Gould	2	Pyramid plunger, 6 in. x 12 in., chain driven from main engine.
11	Bilge pump	Gould	1	Pyramid, 5 in. x 6 in., main engine driven.
12	Sanitary pump	Gould	1	Pyramid, 5 in. x 6 in., main engine driven.
13	Fire pump	Gould	1	Pyramid plunger, 6 in. x 12 in., compressed air driven.
14	Lub. oil purifier	DeLaval	1	
15	Heating system	U. S. Radiator Corp	1	Supplies eight radiators.
16	Steering gear	Johnston-Fries	1	Pneumatic, two double acting cylinders, 12 in. x 35 in.

Electricity on Ms. Tampa

(*Continued from page* 921)

are admirably supplied with artificial light, there are 45 ventilating fans to be cared for. There is an automatic electric radiator in the carpenter store forward; there are two automatic electric heaters for the running water supply to the showers and wash basins in the quarters amidship and in the crew's quarters aft; and in the galley there are an electric coffee urn, an electric water boiler and an electric immersion heater.

Electricity is the servant of the whole ship, and—be it noted—not as a luxury, but as an economy in some cases and as an insurance in others. Examples of the latter are the gyro-pilot, the whistle flasher, the running light tell-tales, the searchlight and the Rich fire detector, all of which add to the ship's security and reduce the perils of sea and port. Economy is the purpose of all the power units above and below deck, as is well known. It is also the reason for the installation of the heating units on the hot-water supply and in the galley. There is no need to keep steam on the boiler when the quarters require no heat: it can be shut down and the hot water obtained electrically. Similarly the galley range has only to be lighted for cooking meals: at all other times of the day or night men going on watch, or coming off, can get themselves hot coffee, tea or soup, etc., from the electrical units.

How the marine electrical art is progressing is again indicated by the fact that TAMPA has the distinction of being the first ship in the world to go on service without a standby battery for the gyro-compass. Earlier motorships might have dispensed with the gyro-compass battery, but this detail escaped notice. Obviously, in a ship where the main engine cannot turn if the electric power fails, cutting off the water and oil pumps, there is no need to provide means for keeping the gyro-compass in action when the generators are dead. Actually, there is a trick device to keep the motor-generator set of the gyro-compass turning during a momentary interruption of the current, such as might occur in changing generators. The low-voltage cutout of the motor-generator set is connected across the d.c. generator of the set and therefore does not operate immediately the current is off the motor, because inertia keeps the armature turning and maintains the voltage from the d.c. generator about 20 sec. to 30 sec. longer.

For the radio there is an emergency battery, of course, because it is required to operate even if the engine room is holed or afire, or unbearable because of smoke or heat from a fire in the holds. The realization of exactly what this means is well exemplified in TAMPA by the connection of one single emergency light to the radio battery, viz., the light in the CO_2 room, the big hope for extinguishing the fire. There is no other emergency light for use when current fails in the engine room.

With a qualified electrician aboard the ship, any electrical alarm can be expected to be kept in working order, and on TAMPA there has been no hesitation about installing alarms. In addition to the emergency alarm or general alarm of the ship, there is an alarm on the supply circuit of the gyro-pilot, another on the supply circuit of the exhauster in the Rich fire-detector cabinet, and six alarms are provided in the engine room, comprising 1 on the cooling water supply, 2 for the lub. oil pumps, 2 for the low level of the daily supply fuel tanks and one repeater of the general alarm.

Diesels Open Up Molasses Trade

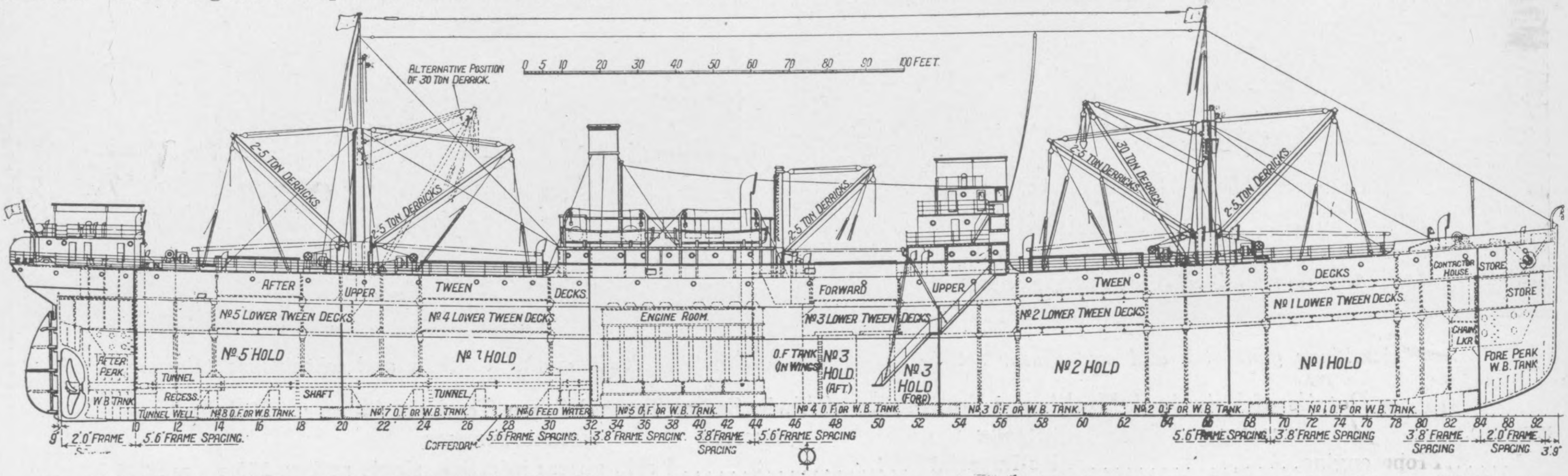
Superior economy of the motorship over the steamer now permits African molasses from Java or South Africa to be sold or delivered in the United States at prices approximating those of Cuban molasses. Cuba hitherto has been the principal source of sugar cane molasses used in this country. The 10,900 ton d.w. motortanker ATHELBEACH, completed only last year, recently brought the first cargo of African molasses, comprising 1,500,000 gal. from Durban and Port Natal to Wilmington, Del. This cargo was consigned to the Eastern Alcohol Corp. and is the second largest supply delivered at this recently established plant.

Ms. Raby Castle in Far Eastern Trade

Characteristics of Ms. Raby Castle

Length b.p.	400 ft. 0 in.
Beam molded	52.2 ft. 0 in.
Depth molded	26 ft. 7 in.
Draft	25 ft. 6 in.
Gross tonnage	4996 tons
Net tonnage	3078 tons
Grain capacity	499,674 cu. ft.
Bale capacity	454,012 cu. ft.
Power	3000 i.hp.
Speed	11½ knots
Passengers	12

MS. RABY CASTLE 8000 ton d.w. motor freighter built in a British shipyard last year loaded a general cargo in New York for Far Eastern ports and sailed late in November. This vessel, owned by James Chambers & Co., Liverpool, England, is operated in New York by Wm. H. Tweddell & Co. She is a good example of modern motorship practice and has all-electric deck and engine-room auxiliary equipment. Powering is carried out by means of a single 3000 i.hp. 8-cylinder Werkspoor Diesel built by North Eastern Marine Engine Co., Wallsend-on-Tyne, England. This engine was the first completed Werkspoor unit with the modified framing arrangement and the exhaust manifold arranged alongside, instead of above, the cylinders. RABY CASTLE made her maiden visit to New York on Sept. 27 when she came to Pier 4, Staten Island with a general cargo from Far Eastern ports. She discharged the cargo and then proceeded to Bluefields, Nicaragua, where she loaded mahogany logs, reaching New York on Nov. 13. Here a general cargo for Far Eastern ports was awaiting her and she is scheduled to run out via Panama and home via Suez.



Ms. Raby Castle fulfills requirements of the Far Eastern trade with her two tiers of 'tween decks and ample cargo handling facilities

The vessel is of shelter deck type, has five cargo holds, one of which is a deep tank, and two 'tween decks. The general arrangement is well shown in the inboard profile, reproduced from our London contemporary, *The Marine Engineer*.

Japanese Motorships for New York

MOTORSHIPS are well on the way to monopoly of the New York-Far East trade. Furness Withy's Prince Line was the first to break in on the service with five fast vessels. Kerr Lines, which previously operated 11 knotters, are shortly putting on six new fast ships. And now motorships ATAGO MARU and ASUKA MARU of the Nippon Yusen Kaisha line are being taken off the North Pacific run from Japanese ports to British Columbia and Puget Sound, to go on the New York-Far East service. They are expected to cut the time of the present steamers operated on this run by the same company several days from New York to Yokohama, via Panama, and considerably more for the whole voyage which takes in Manila, Shanghai, Hong Kong and other calls. These two ships of 10,500 tons d.w. have a sea speed of about 12 knots, ASUKA MARU being powered with B. & W. 4-cycle engines of 3400 total s.hp., and ATAGO MARU having Sulzer 2-cycle engines of the same power. These two motorships have been operating on the North Pacific run since they were put in commission more than a year ago, and have been followed with a good deal of interest on account of having different types of engines of the same power in sister hulls.

ASUKA MARU made her last call at Vancouver, B. C., in November and about the same time ATAGO MARU was starting from Japanese ports for New York. On her last run across the Pacific from Yokohoma to Victoria with a light cargo, her mean draft being 16 ft. ASUKA MARU is reported to have averaged 12.1 knots at 119 r.p.m., with fuel consumption of 13.6 tons a day, the weather being moderate with prevailing winds on the port quarter. The best day's run was at an average speed of 13 knots. Homeward she will be fully loaded to a mean draft of 28 feet, and with prevailing head winds, will not likely do much better than the average of 11½ knots made on the previous westbound trip.

The Chief Engineer says that she is using an average of about 14 gal. of lubricating oil per day at sea for all purposes, the cylinders taking 3 gals. of D.T.E. Extra Heavy, the compressor ¾ gal. Heavy X, and the bearings 9 gal. of Heavy Medium.

The move to the New York run is evidently to meet the keen motorship competition developing between that port and the Far East.

Bessemer Diesels totaling 150 hp. are fitted to the Ohio River stern wheel pushboat VICTOR. Two units situated at the forward end of the vessel drive the stern wheel through horizontal shafting.

Ms. HOLDEN EVANS, twin screw motortanker constructed by Baltimore D. D. Co. in 1917 and powered by two sets of Bolinder surface ignition engines of 1000 total s.hp., has been sold to British owners. This ship has a deadweight of 5000 tons and a gross tonnage of 3254 tons. She is 292.3 ft. b.p. by 47.2 ft. beam by 26.9 ft. depth.

Standard Oil Co. has placed an order for a 21,000 ton motortanker with the Bremer Vulkan yard at Vegesack, N. Germany. The ship is to be powered with double acting 2-cycle M.A.N. Diesels of 4300 b.hp. to be built by the shipyard.

Standard Oil Co. of Indiana will shortly place an order for a large motor tanker for service on the Great Lakes.

A larger Diesel engined yacht will probably be ordered soon by a prominent yachtsman who has owned a Diesel yacht for several years.

Standard Oil Co. (N. J.) has just placed an order with Alexander Stephen & Sons of Linthouse, Glasgow, for two large ocean-going motortankers to operate in the company's foreign fleets. One ship will have Sulzer machinery and the other will have Krupp.

Standard Oil Co. is to establish a distributing station at Anchorage, Alaska, and construction is to commence on this immediately on the completion of a Diesel oil storage tank now building at Seward. The Anchorage installation will consist of a horizontal tank 10 ft. 6 in. diameter by 30 ft. length, a warehouse and covered loading platform.